

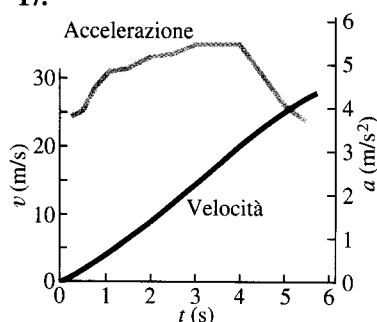
RISPOSTE AI PROBLEMI DISPARI

CAPITOLO 1

1. (a) 1×10^{10} a; (b) 3×10^{17} s.
3. (a) 1.156×10^6 ; (b) 2.18×10^2 ; (c) 6.8×10^{-3} ; (d) 2.7635×10^1 ; (e) 2.1×10^{-1} ; (f) 2.2×10^1 .
5. 11 %.
7. (a) 1×10^1 %; (b) 1 %; (c) 0.2 %.
9. 1.8×10^3 s.
11. 6 %.
13. (a) 0.086 6 m; (b) 0.000 035 V; (c) 0.860 g; (d) 0.000 000 000 600 s; (e) 0.000 000 000 000 012 5 m; (f) 250 000 000 000 volt.
17. (a) 3.9×10^{-9} in; (b) 1.0×10^8 atomi.
19. (a) 0.621 mi/km; (b) 3.28 ft/m; (c) 0.278 (m/s)/(km/h).
21. (a) 9.46×10^{15} m; (b) 6.31×10^4 UA; (c) 7.20 UA/h.
23. (a) 10^4 ; (b) 10^3 ; (c) 10^{-3} ; (d) 10^{10} .
25. ≈ 20 %.
27. $\approx 1 \times 10^5$ cm³.
29. (a) 500 dentisti.
31. $\approx 3 \times 10^8$ kg/a.
33. (a) 3.16×10^7 s; (b) 3.16×10^{16} ns; (c) 3.17×10^{-8} a.
35. 50 000 chip.
37. 1.4×10^3 palline.
39. ≈ 3 ft ≈ 1 m.
41. $\approx 4 \times 10^3$ km.
43. ≈ 4 a.

CAPITOLO 2

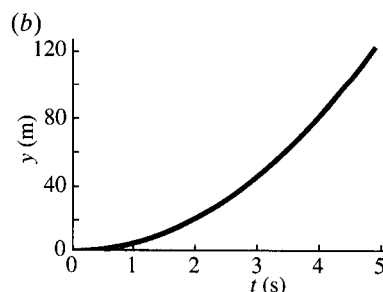
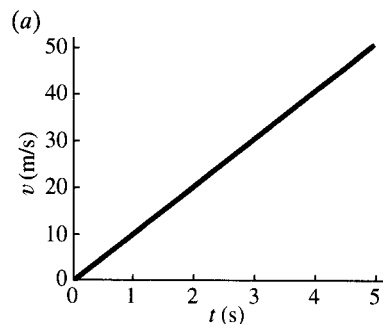
1. 70.8 km/h.
3. 61 m.
5. (a) 203 mi; (b) 61 mi/h.
7. (a) 4.29 m/s; (b) 0.
9. 2.7 min.
11. 55 km/h, 0.
13. 4.3 m/s².
15. (a) 7.41 m/s²; (b) 9.60×10^4 km/h².
- 17.



t (s)	v (m/s)	t (s)	a (m/s ²)
0.0	0.0		
0.125	0.44	0.25	3.8
0.375	1.4	0.50	4.0
0.625	2.4	0.75	4.5
0.875	3.5	1.06	4.9
1.25	5.36	1.50	5.0
1.75	7.85	2.00	5.2
2.25	10.5	2.50	5.3
2.75	13.1	3.00	5.5
3.25	15.9	3.50	5.6
3.75	18.7	4.00	5.5
4.25	21.4	4.50	4.8
4.75	23.9	5.00	4.1
5.25	25.9	5.50	3.8
5.75	27.8		

19. (a) 2.2 m/s², (b) 1.1×10^2 m.
21. 1.5×10^2 m.

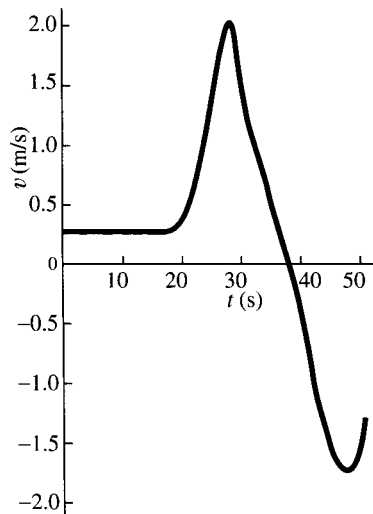
23. 62.5 m.
25. (a) 1.6×10^2 m; (b) 25 s; (c) 12 m, 10 m.
27. (a) 103 m; (b) 64 m.
29. 24.0 s, 240 km/h.
31. 3.1 s.
33. 2.6 s.
35. (a) 8.81 s; (b) 86.3 m/s.
37. 1.5 s.
- 39.



41. 5.22 s.
45. 0.038 s.
47. 52 m.
49. (a) 5.33 s; (b) 40.2 m/s; (c) 89.7 m.
51. (a) 0.28 m/s; (b) 1.2 m/s; (c) 0.28 m/s; (d) 1.6 m/s; (e) -1.0 m/s.

53. (a) 50 s; (b) da 90 s a 107 s;
(c) da 0 a 20 s, e da 90 s a 107 s;
(d) 75 s.
55. (a) 4.7 m/s^2 ; (b) 2.2 m/s^2 ;
(c) 0.3 m/s^2 ; (d) 1.6 m/s^2 .

57.



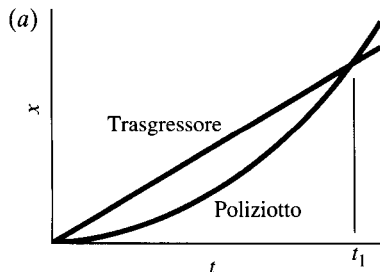
59. (a) negativa; (b) accelerando;
(c) negativa; (d) positiva;
(e) accelerando; (f) positiva;
(g) fermo, zero

61. 6 volte.

63. 209.5 km/h.

65. (a) 3.88 s; (b) 73.9 m;
(c) 38.0 m/s, 48.4 m/s;

67.



- (b) 22.9 s; (c) 2.67 m/s^2 ;
(d) $61.1 \text{ m/s} = 220 \text{ km/h}$.

69. 3.3 m.

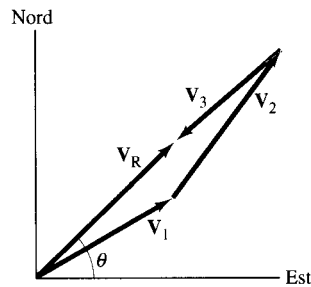
71. Meglio non tentare il sorpasso.

73. 2 pali.

CAPITOLO 3

1. 177 km, 15° a sud rispetto a ovest.

5. 31 m, 44° nord rispetto a est.



7. (a) 2.76 nella direzione $+x$;
(b) 13.86 nella direzione $+x$;
(c) 13.86 nella direzione $-x$.

9. (a) 614 km/h, 489 km/h;
(b) $1.84 \times 10^3 \text{ km}$,
 $1.47 \times 10^3 \text{ km}$.

11. (a) 35.9, 17.3; (b) 39.9, 25.8° sopra l'asse $+x$.

13. (a) 80.7, 1.56° sopra l'asse $-x$;
(b) 80.7, 1.56° sotto l'asse $+x$.

15. (a) 117, 72.1° sotto l'asse $-x$;
(b) 226, 35.5° sotto l'asse $+x$.

17. 5032 m.

19. 5.6 m.

21. 14° e 76° .

23. Fallisce, 34.7 m.

27. 12.9 m.

29. Sei volte più lontano.

31. 5.71 s.

35. (a) 92.6 m; (b) 8.69 s; (c) 539 m;
(d) 68.0 m/s, 24.2° sopra il piano orizzontale.

39. $\theta = \tan^{-1}(gt/v_0)$ sotto il piano orizzontale.

41. 2.9 m/s, 20° rispetto alla riva del fiume.

43. (a) 2.59 m/s, 62.4° rispetto alla costa; (b) 7.77 m a 62.4° rispetto alla costa.

45. (a) 435 km/h, 9.36° est rispetto a sud; (b) 12 km.

47. 1.41 m/s.

49. (a) 1.66 m/s; (b) 3.19 m/s.

51. (a) 120 m; (b) 150 s (2.5 min).

53. 42.9° a nord rispetto a est.

55. 58 km/h, 31° , 58 km/h in verso opposto a v_{12} .

57. 109 km/h.

59. (a) Paralleli; (b) perpendicolari;
(c) $V_2 = 0$.

61. -2.4 m/s^2 (opposta al verso del moto); -1.4 m/s^2 (verso il basso).

63. $v_r = v_T / \tan \theta$.

65. $1.8 \times 10^2 \text{ s}$, 4.8 km, 21 s, 0.56 km.

67. 1.6 m/s^2 .

69. 1.9 m/s, 2.7 s.

71. 61.8° sotto al piano orizzontale.73. 59 m/s, 78° sopra il piano orizzontale.

CAPITOLO 4

1. 69.0 N.

3. $8.8 \times 10^2 \text{ N}$.

5. (a) $6.5 \times 10^2 \text{ N}$; (b) $1.1 \times 10^2 \text{ N}$;
(c) $2.4 \times 10^2 \text{ N}$; (d) 0.

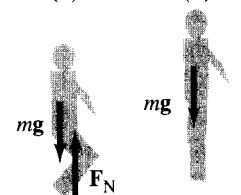
7. $3.4 \times 10^3 \text{ N}$, in verso opposto alla velocità.

9. $m > 1.5 \text{ kg}$.11. $2.1 \times 10^2 \text{ N}$.13. 3.5 m/s^2 (verso il basso).15. a (verso il basso) $\geq 2.2 \text{ m/s}^2$.17. 0.557 m/s^2 .19. (a) 2.2 m/s^2 ; (b) 18 m/s; (c) 93 s.

21. (a) 9.4 m/s; (b) $3.3 \times 10^3 \text{ N}$ verso l'alto.

23. (a) 40 N; (b) 10 N; (c) 0.

25. (a) (b)

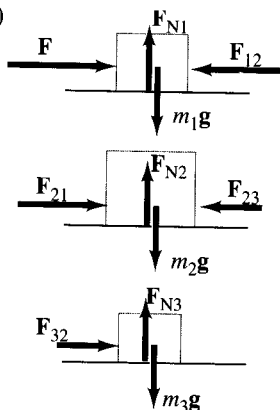


27. (a) 19.0 N, 0.702 m/s^2 , entrambe 57.5° al di sotto dell'asse $-x$;
(b) 14.0 N, 0.519 m/s^2 ,

entrambe 51.0° al di sopra dell'asse $+x$.29. (a) 11 m/s^2 ; (b) 4.3 m/s.

31. (a) $8.01 \times 10^4 \text{ N}$;
(b) $1.25 \times 10^4 \text{ N}$.

35. (a)



(b) $a = F/(m_1 + m_2 + m_3)$;
 (c) $F_{\text{ris1}} = m_1 F/(m_1 + m_2 + m_3)$,
 $F_{\text{ris2}} = m_2 F/(m_1 + m_2 + m_3)$,
 $F_{\text{ris3}} = m_3 F/(m_1 + m_2 + m_3)$;
 (d) $F_{12} = F_{21} = F(m_1 + m_2)/(m_1 + m_2 + m_3)$,
 $F_{23} = F_{32} = Fm_3/(m_1 + m_2 + m_3)$;
 (e) 2.67 m/s^2 , $F_{\text{ris}} = 32 \text{ N}$,
 $F_{21} = F_{12} = 64 \text{ N}$,
 $F_{32} = F_{23} = 32 \text{ N}$.

37. 1.74 m/s^2 , $F_{T1} = 22.6 \text{ N}$,
 $F_{T2} = 20.9 \text{ N}$.

39. (a) $\mu_s = 0.82$; (b) $\mu_k = 0.74$.

41. $\mu_s = 0.41$.

43. 6.7 kg .

45. (a) 2.5 m/s^2 ; (b) $4.4 \times 10^2 \text{ N}$.

47. -7.4 m/s^2 .

49. $\mu_k = 0.40$.

51. 1.8 s , niente.

53. (a) 1.2 m ; (b) 1.6 s .

55. 23 m/s (85 km/h).

57. Troppo ripida.

59. $\phi_{\text{max}} = 31^\circ$.

61. (a) $a = (m_2 - m_1 \sin \theta)g/(m_1 + m_2)$; (b) a verso il basso richiede $m_2 < m_1 \sin \theta$, a verso l'alto richiede $m_2 > m_1 \sin \theta$.

63. $\mu_k = 0.64$.

65. $2.0 \times 10^{-2} \text{ N}$.

67. (b) Sì.

69. 35 m/s (130 km/h).

71. (a) $m_{\text{max}} = 4.6 \text{ kg}$;

(b) $m_{\text{max}} = 3.8 \text{ kg}$.

73. (a) 4.1 m/s^2 , 3.2 m/s^2 ;

(b) $a_1 = 4.1 \text{ m/s}^2$,

$a_2 = 3.2 \text{ m/s}^2$; (c) 3.5 m/s^2 .

75. (a) $\mu_k = (v_0^2/2gd \cos \theta) - \tan \theta$; (b) $\mu_s \geq \tan \theta$.

77. 8.8° .

79. 82 m/s (300 km/h).

81. (a) 11.6 kg ; (b) 0.879 m/s^2 .

CAPITOLO 5

1. $4.25g$ verso l'alto.

3. $5.93 \times 10^{-3} \text{ m/s}^2$ verso il Sole,
 $3.55 \times 10^{22} \text{ N}$ verso il Sole, il Sole.

7. 23 m/s , indipendente dalla massa.

9. $\mu_s \geq 0.84$.

11. 0.16 .

13. (a) $5.8 \times 10^3 \text{ N}$; (b) $4.1 \times 10^2 \text{ N}$;
 (c) 31 m/s .

17. $8.0 \times 10^3 \text{ N}$ giù per la massima pendenza.

19. 14.3 N , 5.91° .

21. 1.1 km .

23. $a_{\text{tan}} = 6.29 \text{ m/s}^2$,
 $a_R = 19.7 \text{ m/s}^2$, $\mu_s \geq 2.11$.

25. $1.52 \times 10^3 \text{ N}$.

27. 1.6 m/s^2 .

29. (a) 2.10 kg su entrambi;

(b) $w_{\text{Terra}} = 20.6 \text{ N}$,

$w_{\text{pianeta}} = 25.2 \text{ N}$.

31. $6.7 \times 10^{12} \text{ m/s}^2$.

33. $4.4 \times 10^7 \text{ m/s}^2$.

35. $2.0 \times 10^{-8} \text{ N}$ verso il centro del quadrato.

37. $6.4 \times 10^{23} \text{ kg}$.

39. $6.3 \times 10^3 \text{ m/s}$.

41. 11 s .

43. 2.0 h .

45. $5 \text{ h } 35 \text{ min}$, $19 \text{ h } 50 \text{ min}$.

47. (a) 20 N (verso la Luna);

(b) $1.8 \times 10^2 \text{ N}$ (in verso opposto).

49. $5.5 \times 10^{29} \text{ kg}$.

51. 0.0587 d (1.41 h).

53. $1.6 \times 10^2 \text{ a}$.

55. $5.4 \times 10^{12} \text{ m}$, nel sistema solare, Plutone.

57. (a) $1.90 \times 10^{27} \text{ kg}$;

(b) $1.90 \times 10^{27} \text{ kg}$,

$1.89 \times 10^{27} \text{ kg}$, $1.89 \times 10^{27} \text{ kg}$.

59. (a) 5.2 a ; (b) No.

61. 9.0 giorni terrestri.

63. 6.1 m/s .

65. $2.1 \times 10^2 \text{ N}$.

67. $3.46 \times 10^8 \text{ m}$ dal centro della Terra.

69. 3.3 m/s^2 verso l'alto.

71. $M_P = g_P r^2/G$.

73. $74 \text{ km/h} < v < 140 \text{ km/h}$.

75. (a) Forza attrattiva

gravitazionale;

(b) $9.6 \times 10^{26} \text{ kg}$.

77. $2.3g$.

CAPITOLO 6

1. $7.35 \times 10^3 \text{ J}$.

3. $1.3 \times 10^4 \text{ J}$.

5. 36.1 m .

7. (a) $8.8 \times 10^5 \text{ J}$; (b) $1.6 \times 10^6 \text{ J}$.

9. 23 J .

11. (a) $1.10Mgh$; (b) $1.10Mgh$.

13. (a) $2.8 \times 10^3 \text{ J}$; (b) $2.1 \times 10^3 \text{ J}$.

15. $1.9 \times 10^2 \text{ J}$.

17. 484 m/s .

19. $-1.64 \times 10^{-18} \text{ J}$.

21. 23% .

23. $3.4 \times 10^2 \text{ N}$.

25. 27 m/s (97 km/h), la massa si elide.

27. 7.1 m/s , 3.5 m/s .

29. 0.34 m .

31. $2.5 \times 10^3 \text{ J}$.

33. (a) $8.1 \times 10^5 \text{ J}$; (b) $8.1 \times 10^5 \text{ J}$;
 (c) sì.

35. $h = 1.6 \text{ m}$, no.

37. 5.14 m/s .

39. (a) 9.2 m/s ; (b) 0.35 m .

41. 199 m/s .

43. (a) 8.03 m/s ; (b) 3.44 m .

45. $E = \frac{1}{2} kx_0^2 = \frac{1}{2} mv^2 + mgx$.

47. $3.7 \times 10^3 \text{ N/m}$.

49. $4.5 \times 10^6 \text{ J}$.

51. (a) 22 m/s ; (b) $2.9 \times 10^2 \text{ m}$.

53. 20 m/s .

55. 0.48 .

57. (a) $1.07 \times 10^3 \text{ km/h}$;
 (b) $2.1 \times 10^3 \text{ N}$.

59. $5.4 \times 10^2 \text{ N}$.

61. (b) 360 kWh ; (c) $1.3 \times 10^9 \text{ J}$;
 (d) $\$43.20$. No.

63. $8.1 \times 10^6 \text{ J}$.

65. 4.57 W .

67. 2.6 m/s .

69. $1.8 \times 10^6 \text{ W}$.

71. (a) $-3.6 \times 10^4 \text{ J}$;
(b) $-3.3 \times 10^3 \text{ N}$;
(c) $-2.5 \times 10^5 \text{ J}$.
73. $1.5 \times 10^3 \text{ J}$.
75. (a) 19 m/s ; (b) -1.4 N .
77. (a) $1.1 \times 10^6 \text{ J}$;
(b) $60 \text{ W} = 0.081 \text{ hp}$;
(c) $4.0 \times 10^2 \text{ W} = 0.54 \text{ hp}$.
79. (a) $h = 2.5r$; (b) $11mg$; (c) $5mg$;
(d) mg .
81. (a) 40 m/s ; (b) $2.6 \times 10^5 \text{ W}$.
85. (a) 29° ; (b) $6.4 \times 10^2 \text{ N}$;
(c) $9.2 \times 10^2 \text{ N}$.

CAPITOLO 7

1. $0.18 \text{ kg}\cdot\text{m/s}$.
3. $5.2 \times 10^7 \text{ N}$, verso l'alto.
5. 12.3 m/s .
7. 0.491 m .
9. $6.7 \times 10^3 \text{ m/s}$.
11. 0.39 m/s .
13. 140 kg .
15. $1.32 \times 10^4 \text{ N}$.
17. $2.1 \text{ N}\cdot\text{s}$.
19. (a) $\approx 5.0 \text{ N}\cdot\text{s}$; (b) 83 m/s .
21. $v_1' = 1.23 \text{ m/s}$, $v_2' = 4.93 \text{ m/s}$.
23. $v_1' = -3.00 \text{ m/s}$ (rimbalzo),
 $v_2' = 2.00 \text{ m/s}$.
25. (a) $v_2' = 1.8 \text{ m/s}$;
(b) $m_2 = 1.1 \text{ kg}$.
27. (a) $m_2 = 0.840 \text{ kg}$; (b) 0.750 .
29. (b) $v_1' \approx -v_1$, $v_2' \approx 0$;
(c) $v_1' \approx v_1$, $v_2' \approx 2v_1$;
(d) $v_1' \approx 0$, $v_2' \approx v_1$.
31. (a) $+M/(m+M)$; (b) 0.964 .
33. 15 m/s .
35. 9.
37. $1.08 \times 10^{-22} \text{ kg}\cdot\text{m/s}$, 30.1°
rispetto alla direzione opposta a
quella dell'elettrone.
39. (a) $m_A v_A + 0 = m_A v_A' \cos \theta_A' +$
 $m_B v_B' \cos \theta_B'$, $0 + 0 =$
 $m_A v_A' \sin \theta_A' - m_B v_B' \sin \theta_B'$;
(b) 0.808 m/s , 33.0° .
41. 141° .
43. $\theta_1' = 76^\circ$, $v_1' = 5.1 \times 10^5 \text{ m/s}$,
 $v_{\text{He}}' = 1.8 \times 10^5 \text{ m/s}$.
47. A 2.74 m dall'estremità
anteriore dell'auto.
49. 1.10 m (est), -1.10 m (sud).

51. Sulla retta passante per i centri
a distanza di $0.27R$ da C , dalla
parte piena.
53. 19% dell'altezza.
55. 9.4% della sua altezza, sì.
57. (a) 6.2 m ; (b) 3.4 m ; (c) 3.8 m .
59. (a) $7D/3$; (b) $5D$.
61. $8.3 \times 10^2 \text{ N}$, circa uguale.
63. $1.4 \times 10^4 \text{ N}$, 43.3° .
65. Sì, colpo a rischio.
67. 4.00 m .
69. 59 mi/h .
71. (a) $2.5 \times 10^{-13} \text{ m/s}$;
(b) 1.7×10^{-17} ; (c) 0.19 J .
73. (b) $0.93 \text{ N}\cdot\text{s}$; (c) 4.2 g .
75. $m \leq M/3$.
77. 29.6 km/s .

CAPITOLO 8

1. (a) $\pi/6 \text{ rad} = 0.524 \text{ rad}$;
(b) $19\pi/60 = 0.995 \text{ rad}$;
(c) $\pi/2 = 1.571 \text{ rad}$;
(d) $2\pi = 6.283 \text{ rad}$;
(e) $7\pi/3 = 7.330 \text{ rad}$.
3. $\theta_{\text{Sole}} = 9.30 \times 10^{-3} \text{ rad}$ (0.53°),
 $\theta_{\text{Luna}} = 9.06 \times 10^{-3} \text{ rad}$ (0.52°).
5. $D_{\text{punto}} = 6.8 \text{ km}$.
7. 33 m/s , $6.2 \times 10^3 \text{ m/s}^2$.
9. (a) 0.105 rad/s ;
(b) $1.75 \times 10^{-3} \text{ rad/s}$;
(c) $1.45 \times 10^{-4} \text{ rad/s}$; (d) zero.
11. 9.5 cm .
13. $D_{\text{Luna}} \approx 3.8 \times 10^3 \text{ km}$.
15. (a) 464 m/s ;
(b) 185 m/s ; (c) 328 m/s .
17. (a) 3.1 rad/s^2 ;
(b) $a_R = 1.9 \times 10^2 \text{ m/s}^2$,
 $a_{\text{tan}} = 1.1 \text{ m/s}^2$.
19. (a) $1.8 \times 10^{-4} \text{ rad/s}^2$;
(b) $a_R = 1.2 \times 10^{-2} \text{ m/s}^2$,
 $a_{\text{tan}} = 7.7 \times 10^{-4} \text{ m/s}^2$.
21. $2.75 \times 10^4 \text{ rev}$.
23. (a) $\alpha = 0.070 \text{ rad/s}^2$;
(b) 40 rpm .
27. (a) -4.4 rad/s^2 ; (b) 7.9 s .
29. $92 \text{ m}\cdot\text{N}$.
31. $1.1 \text{ m}\cdot\text{N}$ (orario).
33. $2.7 \times 10^2 \text{ N}$, $1.8 \times 10^3 \text{ N}$.
35. $0.139 \text{ kg}\cdot\text{m}^2$, la distanza
dall'asse è piccola.
37. $1.2 \times 10^{-10} \text{ m}$.
39. 10 N .
41. $62 \text{ m}\cdot\text{N}$.
43. $8.80 \times 10^2 \text{ rev}$, 10.6 s .
45. (a) 95.2 rad/s^2 ; (b) $9.4 \times 10^2 \text{ N}$.
47. (a) 2.9 m ; (b) 3.6 m .
49. (a) 10.8 rad/s^2 ; (b) 13.0 m/s^2 ;
(c) 653 m/s^2 ; (d) $4.77 \times 10^3 \text{ N}$;
(e) 1.14° .
51. $1.11 \times 10^4 \text{ J}$.
53. $1.70 \times 10^4 \text{ J}$.
55. 3.22 m/s .
57. $2.64 \text{ kg}\cdot\text{m}^2/\text{s}$.
59. 0.38 rev/s .
61. (a) $2 \times 10^{17} \text{ J}$;
(b) $5 \times 10^{20} \text{ kg}\cdot\text{m}^2/\text{s}$.
63. (a) $7.1 \times 10^{33} \text{ kg}\cdot\text{m}^2/\text{s}$;
(b) $2.7 \times 10^{40} \text{ kg}\cdot\text{m}^2/\text{s}$.
65. 4.2 rev/s .
67. 3×10^{-18} .
69. $4.8 \times 10^{-2} \text{ rad/s}$,
 $\text{KE}_2 = 2.0 \times 10^4 \text{ KE}_1$.
71. (a) $\omega_P = -(I_W/I_P)\omega_W$ (basso);
(b) $\omega_P = -(I_W/2I_P)\omega_W$ (basso);
(c) $\omega_P = (I_W/I_P)\omega_W$ (alto);
(d) $\omega_P = 0$.
73. 8.21×10^{-6} .
75. (a) 0.84 m/s ; (b) 0.964 .
77. $2.0 \times 10^9 \text{ rev/d}$.
79. (a) 7.3 m ; (b) 6.8 s .
81. $F_{\text{min}} = Mg[h(2R-h)]^{1/2}/(R-h)$.
83. $h_{\text{min}} = 2.7R_0$.
85. $v_{\text{CM}} = (3gL/4)^{1/2}$.

CAPITOLO 9

1. 370 N , 116° .
3. $1.8 \times 10^3 \text{ m}\cdot\text{N}$.
5. $9.2 \times 10^2 \text{ N}$.
7. $2.94 \times 10^3 \text{ N}$ verso il basso,
 $1.52 \times 10^3 \text{ N}$ verso il basso.
9. 2.3 N .
11. A 3.3 m dall'adulto.
13. $F_{T1} = 1.8 \times 10^2 \text{ N}$,
 $F_{T2} = 2.4 \times 10^2 \text{ N}$.
15. $F_1 = -2.94 \times 10^3 \text{ N}$ (basso),
 $F_2 = 1.47 \times 10^4 \text{ N}$.

17. Cardine superiore: $F_{Ax} = 55.2 \text{ N}$,
 $F_{Ay} = 63.7 \text{ N}$; cardine inferiore:
 $F_{Ax} = -55.2 \text{ N}$, $F_{Ay} = 63.7 \text{ N}$.
19. $F_1 = -1.8 \times 10^3 \text{ N}$ (basso),
 $F_2 = 2.4 \times 10^3 \text{ N}$ (alto).
21. 4.38 kg.
23. $F_T = 1.9 \times 10^2 \text{ N}$,
 $F_W = 1.9 \times 10^2 \text{ N}$, 50° sopra il
piano orizzontale.
25. 89.5 cm dai piedi.
27. $F_T = 2.5 \times 10^2 \text{ N}$,
 $F_{AH} = 2.5 \times 10^2 \text{ N}$,
 $F_{AV} = 2.0 \times 10^2 \text{ N}$.
29. $6.5 \times 10^2 \text{ N}$.
31. 0.50.
33. $1.0 \times 10^2 \text{ N}$.
35. $9.9 \times 10^2 \text{ N}$.
37. $2.7 \times 10^3 \text{ N}$.
39. $1.4 \times 10^3 \text{ N}$ (alto), $2.1 \times 10^3 \text{ N}$
(basso).
41. $2.7 \times 10^3 \text{ N}$.
43. (b) sì;
(c) $D = L \sum_{i=1}^n \frac{1}{2i}$; (d) 32 mattoni.
45. (a) $1.2 \times 10^5 \text{ N/m}^2$;
(b) 2.4×10^{-6} .
47. (a) $1.3 \times 10^5 \text{ N/m}^2$;
(b) 6.6×10^{-7} ; (c) 0.0062 mm.
49. 997 cm³.
51. $9.0 \times 10^7 \text{ N/m}^2$, $9.0 \times 10^2 \text{ atm}$.
53. 0.017 J.
55. $5.1 \times 10^4 \text{ N}$.
57. (a) No; (b) 1.3 mm.
59. $A_{\min 2} = 7.7 \times 10^{-3} \text{ m}^2$,
 $A_{\min 1} = 1.4 \times 10^{-3} \text{ m}^2$.
61. 2.5 cm.
63. $2.5 \times 10^6 \text{ N}$.
65. $+2.3 \times 10^9 \text{ m} \cdot \text{N}$, non si
ribalterà.
67. (a) $Mg[h/(2R - h)]^{1/2}$;
(b) $Mg[h(2R - h)]^{1/2}/(R - h)$.
69. (a) $3.5 \times 10^8 \text{ N/m}^2$; (b) sì;
(c) $8.2 \times 10^6 \text{ N/m}^2$, no.
71. $F_{T1} = 4.54mg$, $F_{T2} = 4.96mg$,
 $h = 158 \text{ m}$.
73. 36 kg.
75. 3.8.
77. 6.3 m.
79. 1.3 m.
81. (a) $2.6 \times 10^2 \text{ N}$; (b) 88 N.

CAPITOLO 10

1. $2.7 \times 10^{11} \text{ kg}$.
3. $4.3 \times 10^2 \text{ kg}$.
5. 0.8477.
7. $1.65 \times 10^4 \text{ N/m}^2$.
9. (a) $3.1 \times 10^5 \text{ N}$ (basso);
(b) $3.1 \times 10^5 \text{ N}$.
11. $1.96 \times 10^3 \text{ kg}$.
13. 13 m.
15. 8.0 km.
17. $9.0 \times 10^5 \text{ N/m}^2$ (relativa); 92 m.
19. (a) 0.34 kg; (b) $1.5 \times 10^4 \text{ N}$
(verso l'alto).
21. 983 kg/m³.
23. 0.199.
25. 12 kg.
27. (a) $1.03 \times 10^3 \text{ kg/m}^3$;
(b) $\rho_{\text{liquid}} = [(m - m_{\text{apparent}})/m]\rho_{\text{oggett}}$.
29. 0.85.
31. $7.9 \times 10^2 \text{ kg}$.
35. 3.8 m/s.
37. $1.2 \times 10^5 \text{ N/m}^2 = 1.2 \text{ atm}$.
39. $1.4 \times 10^5 \text{ N}$.
41. $9.7 \times 10^4 \text{ N/m}^2$.
43. 2.22 m/s, 1.8 atm (relativa).
45. 0.072 Pa·s.
47. $9.9 \times 10^2 \text{ N/m}^2$.
49. 0.12 m.
51. 0.96 (N/m²)/cm.
53. 1×10^{-20} .
55. 0.036 N/m.
57. No.
59. 3.
61. (a) 0.88 m; (b) 0.55 m;
(c) 0.24 m.
63. $1.5 \times 10^2 \text{ N} \leq F \leq 2.2 \times 10^2 \text{ N}$.
65. $4 \times 10^2 \text{ atm}$.
67. 0.63 N.
69. $1.4 \times 10^2 \text{ N}$.
71. 1.1 m.
73. $2.44 \times 10^7 \text{ kg}$.
75. 1.1 W.
77. $1.13 \times 10^4 \text{ N/m}^2$.
79. (a) $2.8 \times 10^2 \text{ m/s}$;
(b) $1.03 \times 10^5 \text{ N/m}^2$ (1.01 atm).

CAPITOLO 11

1. 0.74 Hz.
3. 1.00 m.
5. Coseno.
7. (a) 12 N/m; (b) 1.1 Hz.
9. (a) 2.8 m/s; (b) 2.1 m/s;
(c) 2.0 J; (d) (0.15 m)
 $\cos [2\pi(3.0 \text{ Hz})t]$.
11. $(2k/m)^{1/2}/2\pi$.
13. 10.3 m/s.
15. (a) $4.2 \times 10^2 \text{ N/m}$; (b) 3.3 kg.
17. (a) 0.45 m; (b) 1.34 Hz; (c) 3.6 J;
(d) 2.0 J, 1.6 J.
19. (a) $x = (0.280 \text{ m}) \sin [(29.0 \text{ s}^{-1})t]$;
(b) massimi a 0.0542 s, 0.271 s,
0.488 s, ..., minimi a 0.163 s,
0.379 s, 0.596 s, ...
21. 557 m/s.
23. (a) 0.707 A; (b) 0.866 A.
29. (a) 0.993 m; (b) ritarderà.
31. (a) 0.61 Hz; (b) 0.53 m/s;
(c) 0.044 J.
33. (a) -15° , (b) $+4.6^\circ$, (c) $+15^\circ$.
35. 1.26 m.
37. (a) $1.4 \times 10^3 \text{ m/s}$;
(b) $4.1 \times 10^3 \text{ m/s}$;
(c) $5.1 \times 10^3 \text{ m/s}$.
39. 0.33 s.
41. 2.1 km.
43. 1.0 m.
45. (a) $5.0 \times 10^9 \text{ W/m}^2$;
(b) $5.0 \times 10^{10} \text{ W}$.
47. 1.41.
49. 0.56.
51. 440 Hz, 880 Hz, 1320 Hz,
1760 Hz.
53. 70 Hz, 140 Hz, 210 Hz.
55. 0.097 m.
57. 300 Hz, 600 Hz, 900 Hz.
61. 4.
63. 5.4 km/s.
65. 41° .
67. 0.16 m/s.
69. 0.38 s.
71. 4.0 Hz.
73. (a) 1.4 Hz; (b) 15 J.
75. (a) 784 Hz, 1176 Hz; 880 Hz,
1320 Hz; (b) 1.26; (c) 1.12;
(d) 0.794.

77. (a) $v_2/v_1 = (\mu_1/\mu_2)^{1/2}$;
 (b) $\lambda_2/\lambda_1 = (\mu_1/\mu_2)^{1/2}$; (c) nella
 parte più leggera.
 79. $k = \rho_{\text{acqua}} g A$.
 81. Ritarderà, -12.3 s.

CAPITOLO 12

1. 2.6×10^2 m.
 3. (a) $1.7 \text{ cm} \leq \lambda \leq 17 \text{ m}$;
 (b) 3.4×10^{-5} m.
 5. 5.4×10^2 m.
 7. 1200 m, 300 m.
 9. 1.0 W/m^2 , $1.0 \times 10^{-10} \text{ W/m}^2$.
 11. 1.3.
 13. 6.3×10^5 .
 15. (a) $5.0 \times 10^{-12} \text{ W}$;
 (b) 6.3×10^3 a.
 17. (a) $7.9 \times 10^2 \text{ W}$;
 (b) 2.5×10^2 m.
 19. (a) 136 dB; (b) 99 dB; (c) 57 dB.
 21. 150 dB.
 23. 25 dB.
 25. (a) 2×10^8 ; (b) 2×10^{11} .
 27. 0.17 m.
 29. (a) 570 Hz; (b) 860 Hz.
 31. (a) 76.6 Hz, 230 Hz, 383 Hz,
 536 Hz; (b) 153 Hz, 306 Hz,
 459 Hz, 612 Hz.
 33. 8.0 Hz, sì.
 35. (a) 0.289 m; (b) 869 Hz.
 37. 198 m/s.
 39. (a) 283; (b) 284.
 41. 0.64, 0.20, -2 dB, -7 dB.
 43. 15 Hz, non udibile, 3.8 Hz,
 udibile.
 45. 346 Hz.
 47. 2.2 Hz.
 49. (a) 5.6 Hz; (b) 61 m.
 51. (a) 1950 Hz; (b) 1640 Hz.
 53. 2 Hz.
 55. 9 Hz.
 57. 13 Hz.
 59. 90 battiti/min.
 61. (a) $1.1 \times 10^2 \text{ m/s}$;
 (b) $2.6 \times 10^2 \text{ m/s}$.
 63. (a) 26° ; (b) 23 s.
 65. (a) 2.46° ; (b) 11.1° .
 67. 10.

69. 30 dB.
 71. 333 Hz.
 73. (a) $2.8 \times 10^2 \text{ m/s}$, 44 N;
 (b) 19.5 cm; (c) 880 Hz,
 1320 Hz.
 75. 635 Hz.
 77. (a) 0; (b) 12 Hz; (c) 0.
 79. 6.4×10^2 N.
 81. $\Delta d = (\lambda/4d)[(\ell/2)^2 + d^2]^{1/2}$.
 83. 780 Hz.
 85. 11.5 m.

CAPITOLO 13

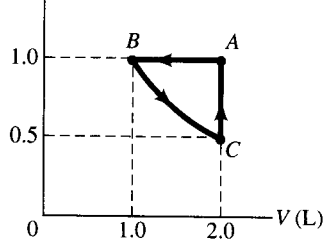
1. 0.548.
 3. (a) 20°C ; (b) 3272°F .
 5. 58°C , -89°C .
 7. 65° .
 9. 0.50 cm.
 11. 5/9.
 15. 5.1 mL.
 17. 0.27 cm^3 .
 23. -2.8×10^{-3} (-0.28%).
 25. $3.5 \times 10^7 \text{ N/m}^2$.
 27. (a) 27°C ; (b) $5.2 \times 10^3 \text{ N}$.
 29. -459.7°F .
 31. 0.854 m^3 .
 33. 2.32 atm.
 35. (a) 0.439 m^3 ; (b) -63°C .
 37. -0.074 (-7.4%).
 39. 0.588 kg/m^3 , il vapor d'acqua
 non è un gas perfetto.
 41. 5.50 cm^3 .
 43. 55.6 moli, 3.34×10^{25} molecole.
 45. $6.4 \times 10^3 \text{ N}$.
 47. $6.1 \times 10^3 \text{ m/s}$.
 49. 5.2.
 51. 31.7°C .
 57. (a) Solido o vapore;
 (b) $5.11 \text{ atm} < P < 73 \text{ atm}$,
 $-56.6^\circ\text{C} < T < 31^\circ\text{C}$.
 59. (a) Vapore; (b) solido.
 61. 0.69 atm.
 63. 11°C .
 65. 3.1 kg.
 67. 120°C .
 69. 29 %.

71. 0.28 s, $5.4 \times 10^{-5} \text{ m/s}$,
 $3.1 \times 10^2 \text{ m/s}$.
 73. (b) Azoto, 6.9%.
 75. -3.8 mL (-1.3%).
 77. $P = \rho RT/M$.
 79. 3×10^2 molecole/ cm^3 .
 81. 11 L, sconsigliabile.
 83. $1.4 \times 10^5 \text{ K}$.
 85. (a) $9.2 \times 10^2 \text{ kg}$;
 (b) $1.1 \times 10^2 \text{ kg}$.
 87. 1.1×10^{44} molecole.
 89. (a) 6.09 cm; (b) $L =$
 $4V_0(\beta_{\text{mercurio}} - \beta_{\text{vetro}})\Delta T/\pi d^2$.
 91. $3.0 \times 10^{-10} \text{ J}$.
 93. $7.6 \times 10^2 \text{ m}$.

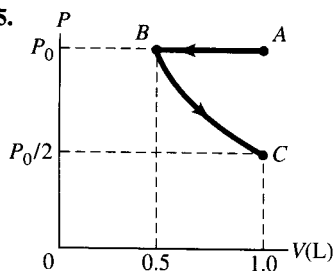
CAPITOLO 14

1. $6.7 \times 10^6 \text{ J}$.
 3. 10.6°C .
 7. $2.1 \times 10^2 \text{ kg}$.
 9. $2.6 \times 10^3 \text{ J/kg}\cdot^\circ\text{C}$.
 11. 10.7 : 4.65 : 1.
 13. 0.124 kg.
 15. 61°C .
 17. 87°C .
 19. $2.3 \times 10^3 \text{ J/kg}\cdot^\circ\text{C}$.
 21. 5.8 min.
 23. 0.334 kg (0.334 L).
 25. 9.6 g.
 27. $4.7 \times 10^3 \text{ kcal}$.
 29. $1.12 \times 10^4 \text{ J/kg}$.
 31. 360 m/s.
 33. (a) 95 W; (b) 33 W.
 35. $4.2 \times 10^{30} \text{ W}$, $1.2 \times 10^4 P_{\text{Sole}}$.
 37. 22 lampade.
 39. 164°C .
 41. 10°C .
 43. 36 W.
 45. 14 h.
 47. $9.8 \times 10^3 \text{ kg}$.
 49. (a) $3.2 \times 10^{26} \text{ W}$;
 (b) $1.1 \times 10^3 \text{ W/m}^2$.
 51. 0.80°C .
 53. 1.96 cm, evaporerebbe.
 55. 4.3 kg.
 59. (a) 44°C ; (b) no.
 61. $1.1 \times 10^{-6} \text{ kg/s}$ (4.1 g/h).

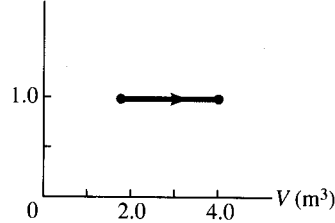
CAPITOLO 15

1. $-1.8 \times 10^3 \text{ J}$.3. $P \text{ (atm)}$ 

5.



7. (a) 0; (b) $+1350 \text{ J}$; (c) aumento.
 9. (a) $3.5 \times 10^2 \text{ J}$; (b) $\Delta U = 0$; (c) $+3.5 \times 10^2 \text{ J}$ (assorbito).
 11. (a) -76 J ; (b) $+24 \text{ J}$; (c) $+52 \text{ J}$; (d) $+28 \text{ J}$; (e) $+23 \text{ J}$.
 13. (a) $+57 \text{ J}$; (b) $+57 \text{ J}$; (c) 0; (d) 48 %.
 15. $1.6 \times 10^2 \text{ W}$.
 17. 28 %.
 19. 30.5 %.
 21. $1.7 \times 10^{13} \text{ J/h}$.
 23. (a) 28 %; (b) $7.46 \times 10^4 \text{ W}$, $1.52 \times 10^9 \text{ J}$ ($3.64 \times 10^5 \text{ kcal}$).
 25. 238°C .
 27. $4.3 \times 10^8 \text{ kg/h}$.
 29. 7.0.
 31. (a) $2.1 \times 10^2 \text{ J}$; (b) $3.5 \times 10^2 \text{ J}$.
 33. 3.2 min.
 35. $+0.31 \text{ kcal/K}$.
 37. $+11 \text{ kcal/K}$.
 39. $+2.2 \text{ cal/K}$.
 41. (a) 75.8 %; (b) $+0.270 \text{ J/K}$; (c) 0.
 43. (b), (a), (c), (d).
 45. (a) $1/379$; (b) $1/1.59 \times 10^{11}$.
 47. 15 MW.
 49. $3.3 \times 10^{13} \text{ J}$.
 51. -401°C .

53. (a) $2.2 \times 10^5 \text{ J}$; (b) $-1.7 \times 10^5 \text{ J}$; (c) $P \text{ (atm)}$ 

55. 69 %.
 57. $2.9 \times 10^3 \text{ J/K}$.
 59. (a) 17; (b) $6.1 \times 10^7 \text{ J}$.
 61. 0.15 J/K .
 63. 17 km^3 , 83 km^2 .

CAPITOLO 16

1. 1.88×10^{14} elettroni.
 3. 11.5 cm.
 5. $2.7 \times 10^{-3} \text{ N}$.
 7. $2.5 \times 10^3 \text{ N}$.
 9. $6.8 \times 10^3 \text{ C}$.
 11. $-1.4 \times 10^2 \text{ N}$ (sinistra), $+5.3 \times 10^2 \text{ N}$ (destra), $-3.9 \times 10^2 \text{ N}$ (sinistra).
 13. $6.20 \times 10^5 \text{ N}$ uscente dal centro del quadrato.
 15. $F_{\text{elettrica}} = 8.2 \times 10^{-8} \text{ N}$, $F_{\text{gravitazionale}} = 3.6 \times 10^{-47} \text{ N}$, 2.3×10^{39} .
 17. (a) $Q_1 = \frac{1}{2} Q_T$; (b) Q_1 (o Q_2) = 0.
 19. A 0.91 m dalla parte della carica negativa.
 21. $1.05 \times 10^{14} \text{ m/s}^2$, opposta al verso del campo elettrico e indipendente dalla velocità.
 23. $+2.0 \times 10^5 \text{ N/C}$ (sud).
 25. $3.30 \times 10^6 \text{ N/C}$ (alto).
 27. $7.12 \times 10^{-10} \text{ N/C}$ (sud).
 29. $2kQa/(a^2 + x^2)^{3/2}$ parallelo al segmento che le congiunge.
 31. $3.80 \times 10^6 \text{ N/C}$ in verso opposto a quello della carica positiva.
 33. (a) $1.73kQ/L^2$ 60° al di sotto dell'asse x negativo; (b) kQ/L^2 30° al di sotto dell'asse x positivo.
 35. 0.10 N/C .
 37. $Q_2 = 4Q_1$.

39. (a) Nella stessa direzione del moto verso destra; (b) $5.1 \times 10^2 \text{ N/C}$.

41. 5.08 m.
 43. $1.02 \times 10^{-7} \text{ N/C}$ (alto).
 45. 1.0×10^7 elettroni.
 47. $2.4 \times 10^{-10} \text{ N}$ (attrazione).
 49. Positiva, $2.2 \times 10^{-7} \text{ C}$.
 51. (a) 0.83 mm; (b) 2.2 ns.
 53. $5.4 \mu\text{C}$.
 55. $+0.19 \text{ N}$ (destra).

CAPITOLO 17

1. $-6.5 \times 10^{-4} \text{ J}$ (svolto dal campo).
 3. $3.4 \times 10^{-15} \text{ J}$, 21 keV.
 5. $4.2 \times 10^4 \text{ V/m}$.
 7. -32.5 kV .
 9. $V_a - V_b = 269 \text{ V}$.
 11. $7.32 \times 10^7 \text{ m/s}$.
 13. $2.40 \times 10^5 \text{ V}$.
 15. $+1.08 \text{ J}$.
 17. 4.2 MV.
 19. (a) $+6.1 \times 10^3 \text{ V}$; (b) $8.8 \times 10^4 \text{ N/C}$, 53° verso nord rispetto a est.
 21. $3.0 \times 10^3 \text{ m/s}$.
 23. $2kq(2b - d)/b(d - b)$.
 25. (a) 0.036 V; (b) 0.025 V; (c) -0.025 V .
 27. $5.2 \times 10^{-20} \text{ C}$.
 29. Zero, forza risultante.
 31. 0.79 pF.
 33. $108 \mu\text{C}$.
 35. $1.5 \times 10^{-10} \text{ F}$.
 37. 26.3 nC.
 39. $4.5 \times 10^4 \text{ V/m}$.
 41. $56 \mu\text{F}$.
 43. $1.09 \times 10^{-3} \text{ J}$.
 45. (a) 3.6 pF; (b) 32 pC; (c) 90 V/m; (d) $1.5 \times 10^{-10} \text{ J}$; (e) capacità, carica e lavoro.
 47. (a) 4 volte; (b) 4 volte; (c) $\frac{1}{2}$ volte.
 49. (a) $2.73 \times 10^{-3} \text{ J}$; (b) $1.10 \times 10^{-3} \text{ J}$; (c) $-1.63 \times 10^{-3} \text{ J}$; (d) l'energia potenziale immagazzinata non si conserva.
 51. $5.4 \times 10^5 \text{ V/m}$.

53. $9.96 \times 10^{-8} \text{ J/m}^3$.
 55. (a) 0.039 eV; (b) 0.039 eV;
 (c) 0.3 keV; (d) 0.029 eV.
 57. 24 mC.
 59. $0.14 \mu\text{C}$.
 61. 10.9 V.
 63. (a) a 4.9 cm dalla carica
 negativa e a 7.4 cm dalla carica
 positiva; (b) a 0.56 cm dalla
 carica negativa verso quella
 positiva e a 2.1 cm dalla carica
 negativa verso l'esterno.
 65. $Q_1 = Q_0 C_1 / (C_1 + C_2)$,
 $Q_2 = Q_0 C_2 / (C_1 + C_2)$,
 $V = Q_0 / (C_1 + C_2)$.
 67. $1.03 \times 10^6 \text{ m/s}$.
 69. 0.10 m/s.
 71. (a) $0.649 \mu\text{F}$; (b) 23 C;
 (c) $4.0 \times 10^8 \text{ J}$.

CAPITOLO 18

1. $1.4 \times 10^5 \text{ C}$.
 3. $2.5 \times 10^{-11} \text{ A}$.
 5. 35 Ω .
 7. $2.1 \times 10^{21} \text{ elettroni/min}$.
 9. 24 Ω , $3.6 \times 10^2 \text{ J}$.
 11. 0.029 Ω .
 13. $R_{Al} = 1.6 R_{Cu}$.
 15. 1/8 della lunghezza, 8.75 Ω ,
 1.25 Ω .
 17. 58.3 $^\circ\text{C}$.
 19. $1.8 \times 10^3 \text{ }^\circ\text{C}$.
 21. (a) 0.28 Ω ; (b) $2.9 \times 10^2 \text{ A}$;
 (c) 31 V, 49 V.
 23. 17 Ω .
 25. 26 V.
 27. (a) 240 Ω , 0.50 A; (b) 32.7 Ω ,
 3.67 A.
 29. 0.092 kWh, 18cent.
 31. (a) 8.6 Ω , 1.1 W; (b) 4 volte.
 33. (a) 0.23 W; (b) 32 mA.
 35. 71%.
 37. (a) 26.2 Ω ; (b) 19 s; (c) 0.12cent.
 39. 26 A, 0.46 Ω .
 41. 0.545 A, 0.386 A.
 43. $5.3 \times 10^2 \text{ V}$.
 45. 6.0 hp, 13 A.
 47. $7.8 \times 10^{-10} \text{ m/s}$.
 49. 6.25 mol/m^3 .

51. $7.0 \times 10^6 \text{ V/m}$.
 53. $5 \times 10^{-11} \text{ J}$, $5 \times 10^{-5} \text{ W}$.
 55. $3.60 \times 10^3 \text{ C}$.
 57. 12 h.
 59. 0.23 S.
 61. $R_2 = \frac{1}{4} R_1$.
 63. 4.0 mm.
 65. 8.4%.
 67. 9.00 Ω .
 69. 1.5 kW.
 71. 0.258 mm, 38.8 m.
 73. $2.1 \times 10^{-3} \text{ F}$.
 75. $5.5 \times 10^{-7} \text{ m}$.

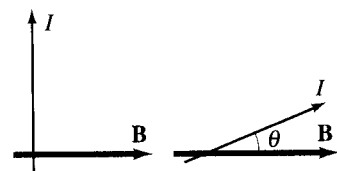
CAPITOLO 19

1. 560 Ω , 35 Ω .
 3. 30 Ω , 50 Ω , 80 Ω , 19 Ω .
 5. Con tre resistenze da 1.0 Ω
 collegate in serie.
 7. 4.6 k Ω .
 9. 450 Ω , 2.6%.
 11. Aggiungendo 960 Ω in parallelo.
 13. 105 Ω .
 15. (a) V_1 e V_2 aumentano; V_3 e V_4
 diminuiscono; (b) I_1 e I_2
 aumentano; I_3 e I_4 diminuiscono;
 (c) diminuiscono; (d) 0, 0.300 A,
 0.150 A, 0.338 A, 0.113 A.
 17. 50 V.
 19. 0.23 Ω .
 21. 0.060 Ω .
 23. 0.16 A.
 25. 17.4 V, 13.3 V.
 27. 43 V, 77 V.
 29. $I_1 = 0.60 \text{ A}$, $I_2 = -0.33 \text{ A}$,
 $I_3 = 0.93 \text{ A}$.
 31. $I_1 = 0.15 \text{ A}$ destra, $I_2 = 0.33 \text{ A}$
 sinistra, $I_3 = 0.18 \text{ A}$ alto.
 33. 0.46 A alto.
 35. 1.30 A.
 37. 22 μF , 0.62 μF .
 39. 10 560 pF, sì.
 41. 300 pF in parallelo.
 43. 0.053 J.
 47. $2C_0 K_1 K_2 / (K_1 + K_2)$.
 49. (a) 6.1 μF ; (b) 7.2 V, 16.8 V,
 24 V.
 51. (a) 41 μC ; (b) 0.63 A, 0.21 A,
 0.42 A.

53. 93 ms.
 55. 7.50 M Ω .
 57. (a) $50 \times 10^{-6} \Omega$ in parallelo;
 (b) 20 M Ω in serie.
 59. 1.0 k Ω in serie, 100 Ω/V .
 61. 5.54 mA.
 63. (a) 2.00 Ω , 3.00 Ω , il circuito 1 è
 migliore; (b) 99 Ω , 101 Ω , i
 circuiti presentano circa lo
 stesso errore; (c) 3.3 k Ω , 5.0 k Ω ,
 il circuito 2 è migliore.
 65. $R_V \geq 240 \text{ k}\Omega$.
 67. $R_1 = 9.4 \text{ k}\Omega$, $R_2 = 6.8 \text{ k}\Omega$.
 69. 288 Ω , 144 Ω .
 71. 7.3 mA.
 73. 0.11 M Ω .
 75. (a) 0.12 A; (b) 0.12 A;
 (c) 64 mA.
 77. 26.4 m.
 79. (a) Parallelo;
 (b) $6.2 \text{ pF} \leq C \leq 37 \text{ pF}$.
 81. 10 resistenze da 0.22 k Ω in serie,
 10 resistenze da 22 k Ω in
 parallelo.
 83. 13 Ω in serie, 30 k Ω in parallelo.
 85. (a) 25 k Ω ; (b) tra b e c.

CAPITOLO 20

1. (a) 7.8 N/m; (b) 5.5 N/m.
 3. 2.68 A.
 5. $7.45 \times 10^{-13} \text{ N}$ sud.
 7. (a) sinistra; (b) sinistra; (c) su;
 (d) dentro; (e) zero; (f) giù.
 9. 1.3 T.
 11.



$F_{\max}$ (entrante nella pagina) F (entrante nella pagina), $\theta = 27^\circ$.

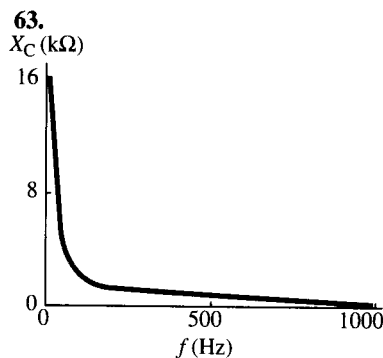
13. 4.47 keV.
 17. 2.0 A, verso il basso.
 19. $2.0 \times 10^{-5} \text{ T}$, 36%.
 21. 0.18 N attrazione.
 23. 3 A.
 25. $\theta = 34^\circ$ ovest rispetto a nord.
 27. $1.6 \times 10^{-17} \text{ T}$.

29. 1.0×10^{-6} T verso l'alto, 2% del campo terrestre.
 31. 5.8×10^{-5} N/m verso l'alto, 3.4×10^{-5} N/m 60° sotto la direzione BC, 3.4×10^{-5} N/m 60° sotto la direzione CB.
 33. 4.1×10^{-5} T.
 35. 5.18×10^{-5} T 10.9° sotto il piano parallelo ai due fili.
 37. Una via di mezzo.
 41. 73.3 μ A.
 43. Diminuisce del 28%.
 47. (a) 2.2×10^{-4} V/m;
 (b) 2.7×10^{-4} m/s;
 (c) 4.6×10^{28} elettroni/m³.
 49. (a) Determina la polarità della f.e.m.; (b) 0.43 m/s.
 51. 70 u, 72 u, 73 u, 74 u.
 53. (a) 2.08×10^{-3} T; (b) uscendo dalla pagina; (c) 5.8×10^7 Hz.
 57. 3.0 T verso l'alto.
 59. 42.8.
 61. 0.93 N.
 63. (a) 4.1 cm; (b) 5.4×10^{-7} s.
 65. 1.50×10^4 A.
 67. (a) 6.6 mm; (b) 1.7 mm.
 69. (c) 48 MeV; (d) la risonanza
 71. (a) 0.512 mm; (b) 0.103 Ω .

CAPITOLO 21

1. 0.050 V.
 3. Antioraria.
 5. -3.2×10^2 V.
 7. (a) antioraria; (b) oraria.
 9. Antioraria.
 11. (a) 14.4 mV;
 (b) 0.120 V/m verso il basso.
 13. (a) 0.84 m/s;
 (b) 0.758 V/m verso il basso.
 15. 0.367 N.
 17. $B\ell vA/\rho(2vt + \ell)$.
 19. 31.0 V.
 23. 0.71 kV, 120 rev/s.
 25. 100 V.
 27. 13 A.
 29. (a) 220 V; (b) 156 V.
 31. In discesa, $V_S/V_P = 0.285$,
 $I_S/I_P = 3.50$.
 33. 55, 4.0 V.

35. (a) Elevatore; (b) 2.4.
 37. 451 V, 56.4 A.
 41. 2.35 cm.
 43. 0.14 H.
 45. 3.4×10^3 spira.
 47. 8.29 V.
 49. (a) Compatibile; (b) 0.18 mH.
 51. $M = \mu_0 N_1 N_2 A / \ell$.
 53. 24.3 Ω , 0.463 H.
 55. 7.5×10^{-5} J, 1.08 s.
 57. (a) 4.47 ms. (b) 1.12 H.
 59. (a) 2.3; (b) 4.6; (c) 6.9.
 61. 1.5 kHz.



63. X_C (k Ω)
 65. 10.1 k Ω , 23.9 mA.
 67. (a) 7.6 k Ω ; (b) 0.37 A.
 69. (a) 18 mV; (b) 50 mV.
 71. (a) 1.6 k Ω ; (b) 1.5 k Ω .
 73. 1.6 kHz.
 75. (a) 65.5 mA; (b) $+10.4^\circ$;
 (c) 7.73 W; (d) $V_R = 118$ V,
 $V_L = 22$ V.
 77. 18 Ω .
 79. 228 Hz.
 81. 3.8×10^5 Hz.
 83. (a) 0.41 μ F; (b) 11 A.
 85. 4 Ω .
 87. (a) Sì; (b) immediatamente;
 (c) Quando la corrente nella
 prima spira va a regime;
 (d) antioraria; (e) sì; (f) in
 allontanamento dall'altra spira.
 89. 7.33×10^{-3} J.
 93. (a) 0.66 A; (b) 9.3.
 95. 82 V.
 97. 0.10 H.
 99. 13.8 Ω , 43.5 mH.
 101. 14 Ω , 75 mH.
 103. 2.2×10^3 Hz, 1.1×10^4 Hz.

CHAPTER 22

1. 1.4×10^{-8} A.
 3. 1.2×10^{15} V/m·s.
 7. 5.25 V/m.
 9. 80.0 kHz, 2.33 V/m, orizzontale
 nord-sud.
 11. 3.0×10^{18} Hz.
 13. 3.33×10^{14} Hz, infrarosso.
 15. 8.33 min.
 17. 3.4×10^3 rad/s.
 19. 9.47×10^{15} m.
 21. 8.5×10^3 lunghezza d'onda,
 3.5 fs.
 23. 4.24 mesi.
 25. 0.796 W/m², 17.3 V/m.
 27. 1.24×10^3 V/m, 4.13×10^{-6} T.
 29. (a) 2.5×10^2 J;
 (b) 2.5×10^9 V/m.
 31. 1.5 pF.
 33. (a) 1.22 μ H; (b) 106 pF.
 35. 441 m.
 37. La stazione AM, 100 volte.
 39. 8.33 min.
 41. 1.43 s.
 43. 38.7 V/m, 1.29×10^{-7} T.
 45. Verso il basso, 614 V/m,
 2.05×10^{-6} T.
 47. (a) 0.40 W; (b) 12 V/m; (c) 12 V.
 49. 1.5×10^{11} W.
 51. (a) In parallelo;
 (b) $8.9 \text{ pF} \leq C \leq 80 \text{ pF}$;
 (c) $1.05 \text{ mH} \leq L \leq 1.22 \text{ mH}$.

CAPITOLO 23

1. 3.0 m.
 5. 5° .
 9. 34.0 cm.
 13. 3.9 m.
 15. Convessi, virtuale, 0.13 m.
 17. (a) Centro di curvatura;
 (b) reale; (c) invertita; (d) -1.
 23. (a) $f = \infty$; (b) $d_i = -d_o$; (c) +1;
 (d) sì.
 25. (a) Concavo; (b) diritta e
 virtuale; (c) 173 cm.
 27. 1.31.
 29. $(2.997026 \pm 0.000030) \times$
 10^8 m/s.
 31. 64.0° .
 33. 61.5° .

35. 4.6 m.
 37. (a) 26.9°; (b) 31.2°; (c) 31.2°.
 41. 1.42.
 43. 3.9×10^{-4} m.
 45. $n \geq 1.414$.
 47. (a) 1.414; (b) no; (c) 1.88.
 49. (a) Convergente; (b) 5.41 D.
 51. (a) 3.39 D, convergente; (b) -16.0 cm, divergente.
 53. (a) -0.26 mm; (b) -0.47 mm; (c) -1.9 mm; (d) 28 mm: grandangolare, 200 mm: teleobiettivo.
 55. -7.6 cm (immagine virtuale dietro la lente), 0.54 mm (diritta).
 57. (a) 75.0 mm; (b) 25.0 mm.
 59. (a) -11.1 cm (divergente), virtuale; (b) +184 cm (convergente).
 61. A metà tra l'oggetto e lo schermo.
 63. (b) 110.8 cm; (c) 110.8 cm.
 65. 7.4 cm dietro la seconda lente.
 69. 1.54.
 71. 13.1 cm.
 73. -43.1 cm (concavo).
 75. +1.3 D.
 77. 5.2 m.
 79. 0.101 m, -2.7 m.
 81. +12 cm.
 83. $0 < -d_o < -f$.
 85. (b) Reale, 20 cm dietro la seconda lente, diritta, della stessa dimensione dell'oggetto.
 87. (c) $\Delta d = (d_T^2 - 4d_T f)^{1/2}$, $\{[d_T + (d_T^2 - 4d_T f)^{1/2}] / [d_T - (d_T^2 - 4d_T f)^{1/2}]\}^2$.
 89. -3.25 m.
 91. $1/f' = [(n/n') - 1][(1/R_1) + (1/R_2)]$; $(1/d_o) + (1/d_i) = 1/f'$, where $1/f' = [(n/n') - 1]/f(n-1)$; $m = h_i/h_o = -d_i/d_o$.

CAPITOLO 24

3. 7.5 μ m.
 5. 3.4 cm.
 7. 0.085 mm.
 9. L'opposto della figura normale.

11. 2.40 mm.
 13. 3.0%.
 15. 0.22°.
 17. 0.61 cm.
 19. 952 nm.
 21. 5.61 μ m.
 23. 0.0230 mm.
 25. (a) $D_{\max} = \lambda$; (b) 400 nm.
 27. 357 nm.
 29. 518 nm, 593 nm, 737 nm.
 31. Un ordine completo.
 33. 6.67×10^3 fenditure/cm.
 35. 10.0°.
 37. 704 nm, 1030 nm.
 39. 1.08 cm.
 41. 228 nm.
 43. 9.05 μ m.
 45. 471 nm.
 49. 699 nm.
 51. 0.250 mm.
 53. 0.289 mm.
 55. 56.7°.
 57. 52°, 38°.
 59. (a) 30°; (b) 18°; (c) 5.7°.
 61. 78.5%.
 63. 24 polarizzatori, ciascuno formante un angolo di 3.75° con il successivo.
 65. 31° da entrambi i lati rispetto alla normale.
 67. 12 500 incisioni/cm.
 69. (a) Costruttiva; (b) distruttiva.
 71. (a) 355 nm.
 73. (a) 0; (b) $0.094I_0$; (c) non si trasmette luce.
 75. 810 nm.
 77. 658 nm, 938 incisioni/cm.
 79. $\frac{1}{2}(m - \frac{1}{2})\lambda/n_{\text{film}}$, $m = 1, 2, 3, \dots$; $\frac{1}{2}m\lambda/n_{\text{film}}$, $m = 0, 1, 2, 3, \dots$; $\frac{1}{2}m\lambda/n_{\text{film}}$, $m = 0, 1, 2, 3, \dots$; $\frac{1}{2}(m - \frac{1}{2})\lambda/n_{\text{film}}$, $m = 1, 2, 3, \dots$.
 81. (a) $0.21I_0$; (b) il secondo o il terzo; (c) il secondo e il terzo.
 83. 0.47 m.

CAPITOLO 25

1. $2.5 \text{ mm} \leq D \leq 39 \text{ mm}$.
 2. (1/60) s.

7. 17 mm.
 9. 54 mm.
 11. +2.3 D.
 13. Sì.
 15. (a) -1.43 D; (b) 28 cm.
 17. -26.8 cm.
 19. 2.1 ingrandimenti.
 21. (a) 17 cm; (b) 10 cm.
 23. (a) 3.78 ingrandimenti; (b) 11.7 mm; (c) a 6.62 cm dalla lente.
 25. (a) -81 cm; (b) 9.5 ingrandimenti; (c) 2.9 ingrandimenti.
 27. 17 cm, 100 cm.
 29. 3.2 cm, 83 cm.
 31. -34 ingrandimenti.
 33. 12 ingrandimenti.
 35. 4.2 m, 8.4 m.
 37. 6.4 ingrandimenti.
 39. 1.5 cm.
 41. (a) 0.85 cm; (b) 230 ingrandimenti.
 43. (a) 14.4 cm; (b) 137 ingrandimenti.
 45. (a) 15.9 cm; (b) 14.8 cm; (c) 1.1 cm; (d) 0.19 cm.
 47. 51.6°, 216 nm.
 49. 3.8×10^{11} m.
 51. 0.46.
 53. (a) 16 km; (b) 0.42'.
 55. 14.0°.
 57. (a) 52.6°; (b) 0.19 nm.
 59. (a) 1; (b) 2.7, 1.
 61. $I_2 = 16I_1$.
 63. 100 mm, 200 mm.
 65. 2.9 ingrandimenti, 4.1 ingrandimenti.
 67. (a) -2.25 ingrandimenti; (b) 4.5 D.
 69. +3.6 D.
 71. 14 cm, 5.1×10^{-6} rad.
 73. -16 ingrandimenti.
 75. 42.7 m.

CAPITOLO 26

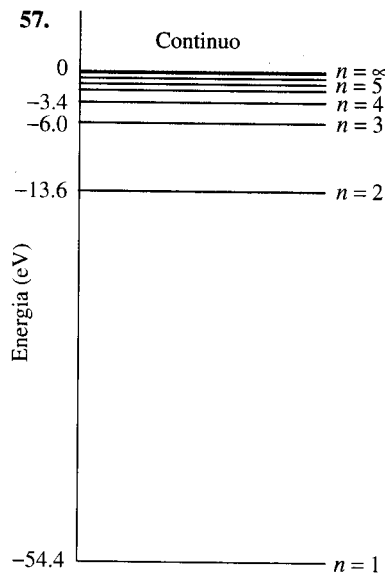
1. (a) 1.000; (b) 0.99995; (c) 0.995; (d) 0.436; (e) 0.141; (f) 0.0447.
 3. 2.07×10^{-6} s.
 5. 5.57 m, 6.68 m.
 7. 0.96c.
 9. (a) 2.3 a; (b) 11 a.
 11. (a) 7.12 m, 1.20 m; (b) 16.3 s; (c) 0.580c; (d) 16.3 s.

13. 3.8×10^{-27} kg.
 15. 0.417c.
 17. (a) 1.5 m/s meno di c; (b) 30 cm.
 19. 5.36×10^{-13} kg.
 21. 8.20×10^{-14} J, 0.511 MeV.
 23. 9×10^2 kg.
 27. (a) 6.3×10^7 kg;
 (b) 1.4×10^{17} kg.
 29. 7.49×10^{-19} kg·m/s.
 31. 0.941c.
 33. $2m_0/[1 - (v^2/c^2)]^{1/2}$,
 nessuna perdita,
 $2m_0c^2(\{1/[1 - (v^2/c^2)]^{1/2}\} - 1)$.
 35. $0.866c$, 4.73×10^{-22} kg·m/s.
 37. 55 MeV (8.7×10^{-12} J),
 1.7×10^{-19} kg·m/s, -8%, -6%.
 39. $0.855c$.
 41. 3.0 T.
 45. 0.80c.
 47. 0.65c.
 49. No.
 51. (a) 0.73c; (b) 5.9 a.
 53. 9.3×10^{-8} s.
 55. 1.02 MeV (1.64×10^{13} J).
 57. 2.2 mm.
 59. (a) 4.4×10^9 kg/s;
 (b) 4.3×10^7 a; (c) 1.4×10^{13} a.
 61. 28.3 MeV.
 63. (a) 1.32×10^{-18} kg·m/s; (b) 0;
 (c) 7.45×10^{-18} kg·m/s.
 65. Non è possibile.

CAPITOLO 27

1. 5.8×10^4 C/kg.
 3. 5.
 5. 7.07×10^3 K.
 7. (a) 10.6 μ m, infrarosso vicino;
 (b) 967 nm, infrarosso;
 (c) 0.73 mm, infrarosso lontano.
 9. (a) 6.0×10^{-34} J; (b) 1.5×10^{35} ;
 (c) 6.8×10^{-36} , non misurabile.
 11. 9.4 μ m.
 13. 4.23×10^{-7} eV.
 15. 2.4×10^{13} Hz, 1.2×10^{-5} m.
 17. 400 nm.
 19. Rame e ferro.
 21. 0.62 eV.
 23. (a) 1.08 eV; (b) nessuna
 emissione di elettroni.
 25. 3.75 eV.

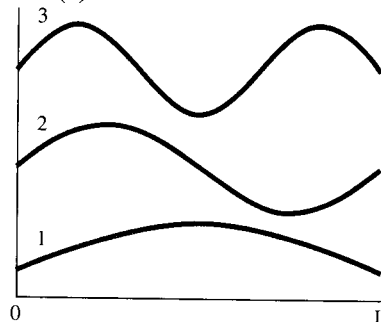
27. 1.9×10^{-24} kg·m/s,
 6.3×10^{-33} kg.
 29. 212 MeV, 5.85×10^{-15} m.
 31. (a) 2.43×10^{-12} m;
 (b) 1.32×10^{-15} m.
 33. (a) 5.90×10^{-3} , 1.98×10^{-2} ,
 3.89×10^{-2} ; (b) 60.8 eV, 204 eV,
 401 eV.
 35. (a) 9.21×10^{-17} J (576 eV);
 (b) 0.105 nm.
 37. 7.2×10^{-12} m.
 39. 8.6×10^{-12} m, gli effetti di
 diffrazione sono trascurabili.
 43. 2.6×10^{-11} m.
 47. 3.2×10^{-3} .
 49. 3.4 eV.
 51. 122 eV.
 53. 52.5 nm.
 55. da $n = 1$ a $n = 3$.



59. -27.2 eV, +13.6 eV.

61. Giustificato.

65. (a)



(c) 150 eV; (d) 1.6×10^{-66} J,
 4.8×10^{-33} m/s; (e) 0.14 nm.

67. 3.28×10^{15} Hz.
 71. 2.78×10^{21} fotoni/(s·m²).
 73. 8.3×10^6 fotoni/s.
 75. 4.7×10^{-14} m.
 77. 10.2 eV.
 79. 4.4×10^{-40} , sì.
 81. 14.2 MeV.
 85. 5×10^{-12} m.

CAPITOLO 28

1. 3.6×10^{-7} m.
 3. $\pm 1.3 \times 10^{-11}$ m.
 5. 6.6×10^{-8} eV.
 7. 3.0×10^{-10} eV/c².
 9. 1.4×10^{-3} m, 9.1×10^{-33} m.
 13. (b) Incertezza infinita.
 15. $m_l = -4, -3, -2, -1, 0, 1, 2$,
 $3, 4$; $m_s = -\frac{1}{2}, +\frac{1}{2}$.
 17. $(1, 0, 0, -\frac{1}{2})$, $(1, 0, 0, +\frac{1}{2})$, $(2, 0$,
 $0, -\frac{1}{2})$, $(2, 0, 0, +\frac{1}{2})$, $(2, 1, -1$,
 $-\frac{1}{2})$, $(2, 1, -1, +\frac{1}{2})$, $(2, 1, 0, -\frac{1}{2})$
 $).$
 19. 32 stati.
 21. $l \geq 3$, $n \geq l + 1$ (minimo 4),
 $m_s = -\frac{1}{2}, +\frac{1}{2}$.
 25. (a) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4$;
 (b) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4$
 $d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^1$;
 (c) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4 d^{10}$
 $4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^3 6d^1 7s^2$.
 27. (a) 6; (b) -0.378 eV;
 (c) 5.78×10^{-34} kg·m²/s;
 (d) $m_l = -5, -4, -3, -2, -1$,
 $0, 1, 2, 3, 4, 5$.
 29. (a) 1.56; (b) 1.4×10^{-10} m.
 33. 41 kV.
 35. 0.18 nm.
 37. 0.061 nm, lo stato $n = 2$
 costituisce una parziale
 schermatura.
 39. 0.018 J, 5.8×10^{16} fotoni.
 41. r_1 , raggio di Bohr.
 43. 0, 4.72×10^{-34} kg·m²/s.
 45. (a) 3.1×10^{-34} m;
 (b) 1.8×10^{-32} kg·m/s;
 (c) 1.6×10^{-30} m.
 47. 3.8×10^3 C°/min.
 49. (a) 45°, 90°, 135°; (b) 35.3°,
 65.9°, 90°, 114.1°, 144.7°;
 (c) 30.0°, 54.7°, 73.2°, 90°,
 106.8°, 125.3°, 150.0°; (d) 5.71°,
 0.0573°.

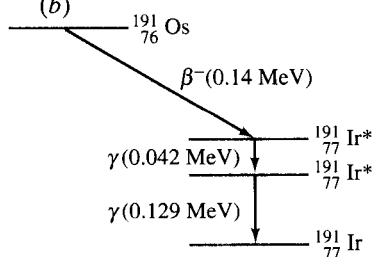
CAPITOLO 29

1. 5.13 eV.
3. 4.6 eV.
5. 1.4 eV.
9. (a) 1.79×10^{-4} eV;
(b) 7.16×10^{-4} eV, 1.73 mm.
11. 2.35×10^{-10} m.
15. (a) 680 N/m; (b) 2.1 μ m.
17. 0.283 nm.
21. 1.1 μ m.
23. Si può usare, 1.09 μ m.
25. 9.2×10^5 .
27. 0.89 μ m.
29. 8.6 V.
33. (a) 38 mA; (b) 76 mA.
35. 0.53 V.
37. (a) 2.5×10^2 ; (b) 2.3×10^4 .
39. 13 eV.
41. (a) -5.3 eV; (b) 5.0 eV.
43. (a) 0.094 eV; (b) 0.63 nm.
45. (a) $146 \text{ V} \leq V \leq 326 \text{ V}$;
(b) $3.34 \text{ k}\Omega \leq R_{\text{car}} < \infty$.
47. 2.0×10^{-9} .

CHAPTER 30

1. $3727 \text{ MeV}/c^2$.
3. 1.9×10^{-15} m.
5. (a) 0.99945; (b) 1.2×10^{-14} ;
(c) $2.3 \times 10^{17} \text{ kg/m}^3$, 10^{14} volte.
7. 28 MeV.
9. $^{31}_{15}\text{P}$.
11. (a) $1.8 \times 10^3 \text{ MeV}$; (b) 730 MeV.
13. 7.48 MeV.
15. 18.7 MeV.
17. (a) 12.1 MeV; (b) 15.7 MeV,
forza elettrostatica repulsiva.
19. 59.93525 u.

21. 0.783 MeV.
23. β^+ , $^{22}_{11}\text{Na} \rightarrow ^{22}_{10}\text{Ne} + \beta^+ + \nu$,
1.82 MeV.
25. $^{228}_{90}\text{Th}$, 228.02883 u.
27. (a) $^{32}_{16}\text{S}$; (b) 31.97207 u.
29. 0.861 MeV.
31. 0.0718 MeV, 4.27 MeV.
33. 0.960 MeV, 0.960 MeV, 0.
35. 3.0 h.
37. 2.1 min.
39. 0.0625.
41. (a) 0.0625; (b) 0.0442.
43. (a) 2.44×10^{12} disintegrazioni/s;
(b) 2.43×10^{12} disintegrazioni/s;
(c) 4.48×10^5 disintegrazioni/s.
45. 5.0×10^{10} disintegrazioni/s.
47. (a) $1.38 \times 10^{-13} \text{ s}^{-1}$;
(b) 5.38×10^8 disintegrazioni/min.
49. 34 disintegrazioni/s.
51. 3.4 mg.
53. 8.6×10^{-7} .
55. $^{211}_{82}\text{Pb}$.
57. $N_0(1 - e^{-\lambda t})$.
59. (a) $2.29 \times 10^{17} \text{ kg/m}^3$;
(b) 180 m; (c) 2.58×10^{-10} m.
61. 28.6 eV.
63. 41 a.
65. 6×10^3 a.
67. $6.65 T_{1/2}$.
71. (a) $^{191}_{77}\text{Ir}$;
(b)



73. (a) 550 MeV; (b) 2.5×10^{12} J.
75. (a) 2.5×10^5 a; (b) nessuna
variazione.

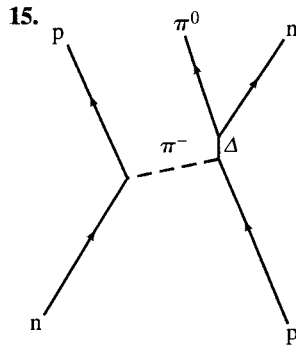
CAPITOLO 31

1. $^{28}_{13}\text{Al}$, β^- , $^{28}_{14}\text{Si}$.
3. Si.
5. 18.000953 u.
7. (a) Si; (b) 0.53 MeV.
9. (a) Si; (b) 6.49 MeV.
11. 41.6 MeV.

13. (a) ^3He incidente acquista
un neutrone; (b) $^{11}_6\text{C}$;
(c) 1.857 MeV, esotermica.
17. 126.5 MeV.
19. 6.3×10^{18} fissioni/s.
21. 482 kg.
23. 1.49.
29. 0.120 g.
31. (a) 13.93 MeV; (b) 4.3 MeV;
(c) 3.3×10^{10} K.
33. 3.23×10^9 J, 65 volte.
35. (a) 4.8×10^{31} particelle/ m^3 ;
(b) 6×10^{-12} s.
37. 1000 rad.
39. 35 J.
41. 4 d.
43. 8.9×10^{-5} rad/d.
45. (a) $^{131}_{53}\text{I} \rightarrow ^{131}_{54}\text{Xe} + ^0_{-1}\text{e} + \bar{\nu}$;
(b) 27 d; (c) 8.0×10^{-9} g.
47. (a) $^{218}_{84}\text{Po}$; (b) radioattive,
emissione α , emissione β^- ,
3.1 min; (c) chimicamente
attivo; (d) 150 μCi , 0.63 μCi .
49. (a) $^{12}_6\text{C}$; (b) 5.70 MeV.
51. 1.0043.
53. 55 mrem/a.
55. 4.5 m.
57. (a) $1.54 \times 10^3 \text{ kg/a}$;
(b) $4.8 \times 10^6 \text{ Ci}$.
59. (a) $4.0 \times 10^{26} \text{ J/s}$;
(b) 3.8×10^{38} protoni/s;
(c) 10^{11} a.
61. (a) 3.7×10^3 decadimenti/s;
(b) 5.2×10^{-2} rem, circa il 15%
del fondo naturale.

CAPITOLO 32

1. 9.44 GeV.
3. 1.6 T.
5. 13 MHz.
7. (a) 8.7 MeV, $2.0 \times 10^7 \text{ m/s}$;
(b) 4.3 MeV, $2.0 \times 10^7 \text{ m/s}$;
(c) 13 MHz (per entrambi).
9. (a) 0.65 T; (b) 4.9 MHz;
(c) 200 rev; (d) 41 μs ;
(e) 0.63 km.
11. 2.2×10^6 km, 7.5 s.
13. 3.0 T.



19. 33.9 MeV.

21. 1.879 GeV.

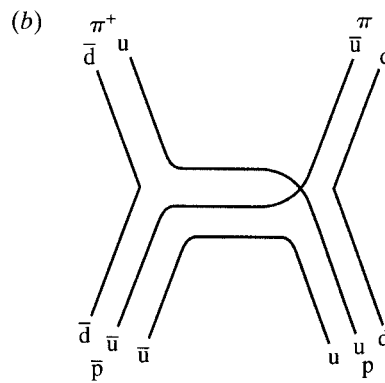
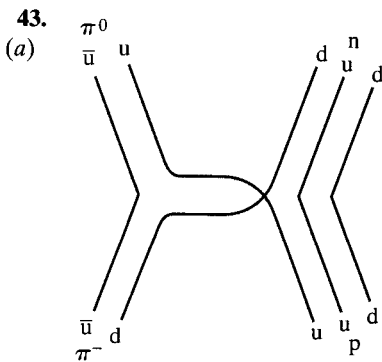
23. (a) Proibito; (b) proibito; (c) possibile.

25. 1.32×10^{-15} m.27. 1.53×10^{-3} nm.29. $KE_n = 494.0$ MeV,
 $KE_p = 493.4$ MeV.

31. No, 292.4 MeV.

33. 7.5×10^{-21} s.

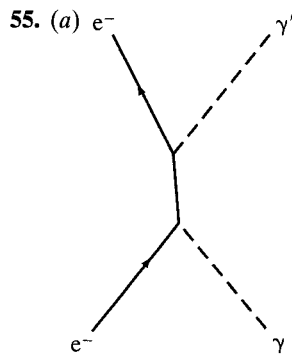
35. (a) 1.3 keV; (b) 8.9 keV.

37. (b) $B^+ = \bar{b}u$, $B^0 = b\bar{d}$,
 $\bar{B}^0 = \bar{b}d$.39. (a) p; (b) $\bar{\Sigma}^+$; (c) K^- ; (d) π^- ;
(e) D_s^- .41. $c\bar{s}$.45. (a) 0.38 A; (b) 98 m/s
(≈ 350 km/h).

47. (a) 1.002 MeV; (b) 1876.6 MeV.

49. (a) 37.8 MeV;
(b) $KE_p = 5.37$ MeV,
 $KE_\pi = 32.4$ MeV.51. 133.5 MeV/ c^2 .

53. 52.4 MeV.



CAPITOLO 33

1. 5.3 a.l.

5. $0.078''$, 13 pc.7. $\phi_1 = \frac{1}{2}\phi_2$.9. 48 W/ m^2 .11. 1.4×10^{-4} kg/ m^3 .13. 1.8×10^9 kg/ m^3 , 3×10^5 volte.15. -0.0941 MeV, 7.365 MeV.17. (a) 9.595 MeV; (b) 7.6 MeV;
(c) 6×10^{10} K.19. $d_2 = 6.5d_1$.23. 540° .25. 1.0×10^8 a.l.27. (a) 2×10^{10} a; (b) 1×10^{10} a.29. 0.328c, 4.0×10^9 a.l.33. 6 nucleoni/ m^3 .35. (a) 10^{-5} s; (b) 10^{-7} s; (c) 10^{-4} s.

37. 5.0 ly.

39. 2×10^{10} .41. 1 atomo/ km^3 ogni 7 a.

43. 2.

45. 0.88c.

47. $\pm 2.3 \times 10^{-3}$.