1) C

2) B

3) A

4) B

5) A

6) D

7) D

8) D

9) A

10) A

11) B

12) A

13) B

14) D

15) B

16) D

17) C

18) D

19) B

20) A

21) D

22) D

23) A

24) C

25) C

26) C

27) C

28) A

29) C

30) A

31) C

32) A

33) A

34) B

35) D

36) C

37) B

38) A

39) D

40) C

41) B

42) C

43) C

44) D

45) D

46) D

47) A

48) C

49) B

50) A

51) B

52) C

53) A

54) D

55) D

56) A

57) C

58) D

59) D

60) D

61) A

62) C

63) B

64) A

65) A

66) A

67) A

68) A

69) A

70) B

71) B

72) A

73) C

74) A

75) B

76) D

77) A

78) C

79) C

80) D

81) D

82) C

83) D

84) C

85) B

86) A

87) C

88) 2.00 s

WORK SHOWN: $a = \frac{\Delta v}{t}$, $t = \frac{\Delta v}{a}$, $t = \frac{9.80 \text{ m/s}}{9.81 \text{ m/s}^2}$, $t = 1.00$ s, $t = 2.00$ s OR $a = \frac{\Delta v}{t}$, $t = \frac{\Delta v}{a}$, $t = \frac{(-9.80 \text{ m/s}) - (9.80 \text{ m/s})}{-9.81 \text{ m/s}^2}$, $t = \frac{-19.6 \text{ m/s}}{-9.81 \text{ m/s}^2}$, $t = 2.00$ s

89) A

90) C

91) A

92) B

93) C

94) C

95) D

96) B

97) A

98) A

99) C

100) D

101) D

102) A

103) C

104) B

105) D

106) D

107) B

108) B

109) C

110) B

111) D

112) C

113) D

114) A

115) D

116) B

117) D

118) A

119) D

120) B

121) D

122) D

123) B

124) C

125) B

126) B

127) D

128) C

129) A

130) B

131) C

132) B

133) C

134) D

135) C

136) B

137) D

138) A

139) A

140) C

141) B

142) B

143) A

144) C

145) A

146) C

147) A

148) A

149) C

150) D

151) D

152) B

153) B

154) B

155) A

156) A

157) D

158) A

159) B

160) B

161) A

162) D

163) B

164) A

165) A

166) D

167) B

168) A

169) A

170) A

171) A

172) A

173) D

174) A

175) B

176) D

177) A

178) B

179) C

180) C

181) A

182) C

183) A

184) B

185) B

186) C

187) A

188) A

189) C

190) A

191) D

192) D

193) C

194) B

195) D

196) A

197) C

198) A

199) B

200) C

201) D

202) A

203) C

204) C

205) B

206) A

207) A

208) C

209) D

210) D

211) D

212) D

213) B

214) B

215) D

216) B

217) A

218) B

219) B

220) A

221) A

222) A

223) B

224) A

225) C

226) B

227) C

228) B

229) D

230) D

231) A

232) C

233) C

234) A

235) C

236) B

237) D

238) C

239) B

240) B

241) A

242) A

243) C

244) A

245) A

246) A

247) B

248) D

249) A

250) A

251) A

252) B

253) D

254) SAMPLE ANSWERS: magnitude OR size OR direction

255) SAMPLE ANSWERS: A scalar quantity has magnitude only. A vector quantity has both magnitude and direction. OR A vector quantity has direction. OR A scalar quantity has no direction.

256) 8.60 km OR 8.6 km

257) 12.00 km OR 12. km OR 12 km

258) $\frac{m}{s^2}$

WORK SHOWN: $\frac{v^2}{d} = \frac{(m/s)^2}{m} = \frac{m^2/s^2}{m} = \frac{m}{s^2}$

259) SAMPLE ANSWER: In order to obtain the measurements necessary for this experiment, the physics students would need to set up the traffic cones to mark the distance from the incline to a point after the incline. Next they would need to use the tape measures to determine the distance from the fist traffic cone at the incline to the last traffic cone after the incline. The students would then use their stopwatches to record the time for the student on skates to coast from the incline to the last traffic cone. The distance and time measurements are adequ[illegible] data to determine the students acceleration.

260) SAMPLE ANSWER: $d = v_i t + \frac{1}{2}at^2$ OR $a = \frac{2d}{t^2}$

261) 2.4 m/s^2

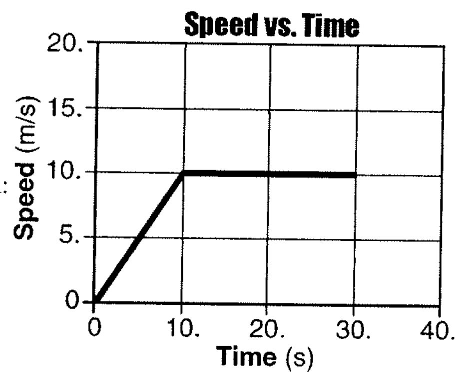
WORK SHOWN: $a = \frac{\Delta v}{t}$, $a = \frac{25\ m/s - 13\ m/s}{5.0\ s} = 2.4\ m/s^2$

262) 19 m/s

263) SAMPLE ANSWERS: 2.0 m/s^2 west OR -2.0 m/s^2 east

264) (a) 10. m/s;

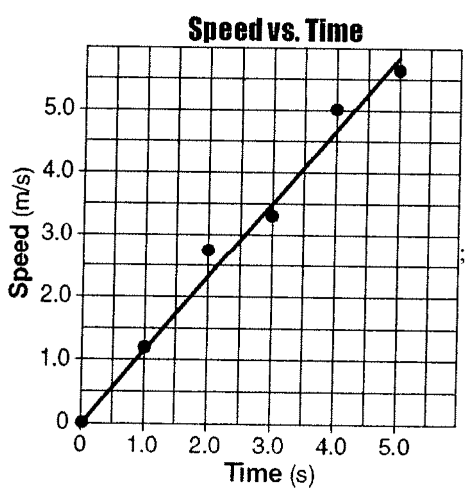
(b) SAMPLE ANSWER:



265) 50. m

WORK SHOWN: $d = v_i t + \frac{1}{2}at^2$, $d = 0 + \frac{1}{2}(1.0\ m/s^2)(10.\ s)^2 = 50.\ m$ OR $d = \text{area} = \frac{1}{2}bh$, $d = \frac{1}{2}(10.\ s)(10.\ m/s) = 50.\ m$

266) (a-c)



;

(d) 1.2 m/s^2

267) SAMPLE ANSWERS: Air friction acts on the feather. OR The feather is not in free fall.

268) (a) 30.° (±2°);

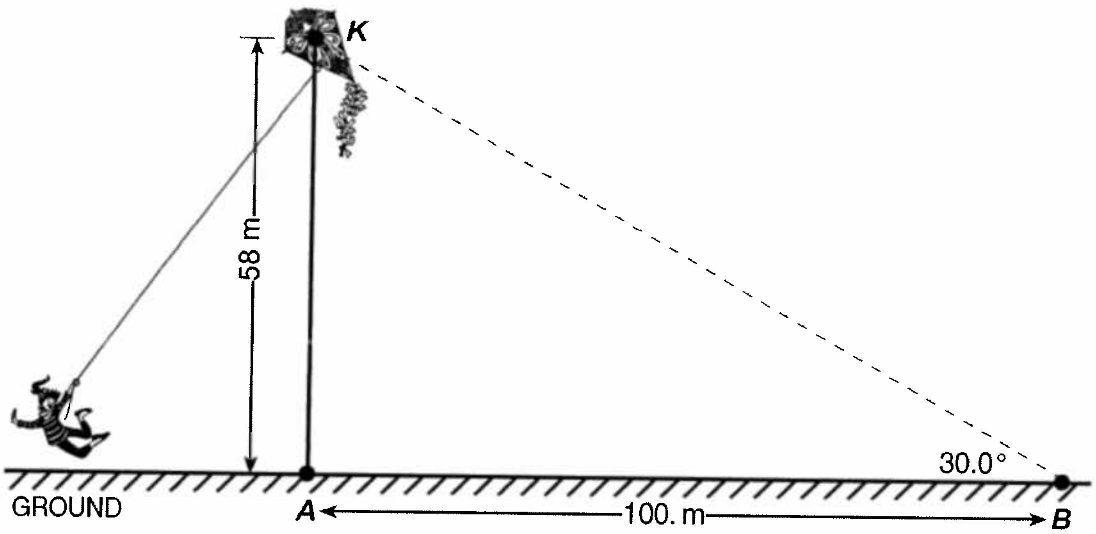
(b) 140 m (±20 m);

(c) 240 m OR 140 m + 100 m;

(d) 7 seconds

WORK SHOWN: $\Delta s = v_i \Delta t + \frac{1}{2}a(\Delta t)^2$, $\Delta s = \frac{1}{2}a(\Delta t)^2$, $\Delta t = \sqrt{\frac{2\Delta s}{a}}$, $\Delta t = \sqrt{\frac{2(240\text{ m})}{9.8\text{ m/s}^2}} = 7.0\text{ s}$ OR $s = \frac{1}{2}at^2$ (from rest), $t = \sqrt{\frac{2s}{a}}$, $t = \sqrt{\frac{2(240\text{ m})}{9.8\text{ m/s}^2}} = 7\text{ s}$

269) (a)



;

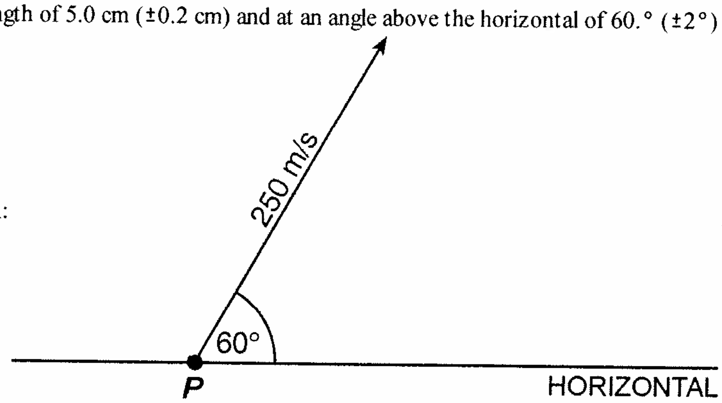
(b) 58 m (±2 m);

(c) 3.4 s

WORK SHOWN: $d = v_i t + \frac{1}{2}at^2$ OR $d = \frac{1}{2}at^2$, $t = \sqrt{\frac{2d}{a}}$, $t = \sqrt{\frac{2(58\text{ m})}{9.81\text{ m/s}^2}} = 3.4\text{ s}$

270) (a) an arrow drawn a length of 5.0 cm (±0.2 cm) and at an angle above the horizontal of 60.° (±2°)

SAMPLE ANSWER:



;

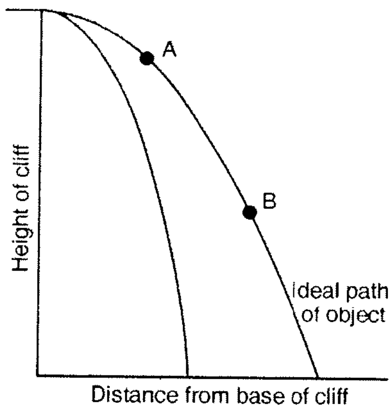
(b) 125 m/s (±10 m/s)

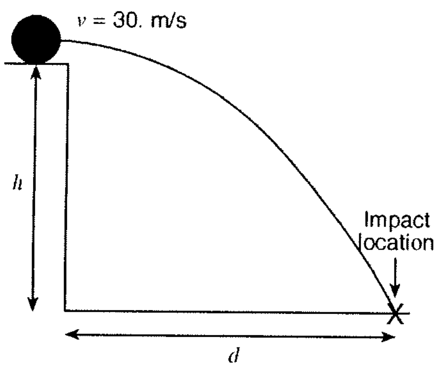
271) SAMPLE ANSWERS: no force on object in horizontal direction OR The only force is vertical. OR Gravity acts only vertically.

272) 75 m

273) SAMPLE ANSWERS: The horizontal velocities at *A* and *B* are the same. OR The horizontal component... is constant. OR ...the same.

274) SAMPLE ANSWERS: Velocity (or vertical velocity) at *A* is less than at *B*. OR less OR Velocity (or vertical velocity) at *B* is greater than at *A*.

275) SAMPLE ANSWER: 

276) SAMPLE ANSWER: 

277) 75 m

WORK SHOWN: $d = v_i t + \frac{1}{2}at^2$, $d = (30.\ \text{m/s})(2.5\ \text{s}) + \frac{1}{2}(0\ \text{m/s}^2)(2.5\ \text{s})^2 = 75\ \text{m}$ OR $\bar{v} = \frac{d}{t}$, $d = \bar{v}t$, $d = (20.\ \text{m/s})(2.5\ \text{s}) = 75\ \text{m}$

278) $\sqrt{\frac{2h}{g}}$

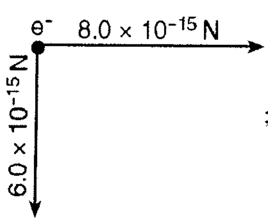
WORK SHOWN: $d = v_i t + \frac{1}{2}at^2$, $t = \sqrt{\frac{2d}{a}}$, $t = \sqrt{\frac{2h}{g}}$ OR

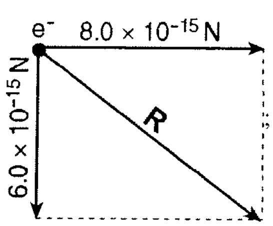
$h = v_i t + \frac{1}{2}gt^2$, $h = \frac{1}{2}gt^2$, $t = \sqrt{\frac{2h}{g}}$

279) 2.40 m/s

WORK SHOWN: $p = mv$, $v = \frac{p}{m}$, $v = \frac{2.40 \times 10^3\ \text{kg} \cdot \text{m/s}}{1.00 \times 10^3\ \text{kg}} = 2.40\ \text{m/s}$

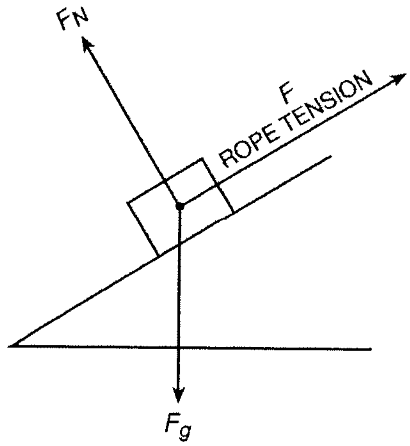
280) SAMPLE ANSWERS: west OR opposite OR backward

281) (a) 

; (b) 

; (c) 10.0×10^{-15} N ($\pm 0.2 \times 10^{-15}$ N) OR 1.00×10^{-14} N ($\pm 0.02 \times 10^{-14}$ N);

(d) 53° (±2°)

282) 

283) west

284) 780 N

WORK SHOWN: $F_f = \mu F_N$, $F_N = \frac{F_f}{\mu}$, $F_N = \frac{39\text{ N}}{0.05}$, $F_N = 780$ N

285) Measurements required: normal force (weight or mass) of block, friction force; Equipment needed: spring scale (and balance if mass of block is used) or computer force sensor; Procedure: The procedure must include a means of finding the normal force and the force of friction AND a means of using them to determine the coefficient of friction (i.e. using the equation OR finding the slope of the graph).; Equation(s) needed: $F_f = \mu F_N$ (and $F_g = mg$ if mass if found first)

SAMPLE ANSWER: To determine the coefficient of friction between a block and the table, I would need to measure the normal force or weight of the block, and the force of friction. The equipment needed is a spring scale. First I would hang the block on the scale to find its weight. Then I would pull the block smoothly (or at constant speed) across the table with the spring scale to find the force of friction. On measured the weight and friction forces, I would use the formula $F_f = \mu F_N$ to calculate the coefficient of friction.

286) 20. N OR 20 N

287) 14.7 N OR 15 N

WORK SHOWN: $F_f = \mu F_N$, $F_f = (0.15)(10.\text{ kg})(9.81\text{ m/s}^2) = 14.7$ N OR 15 N

288) 156 N

WORK SHOWN: $F_f = \mu F_N = (0.200)(780.\text{ N}) = 156$ N

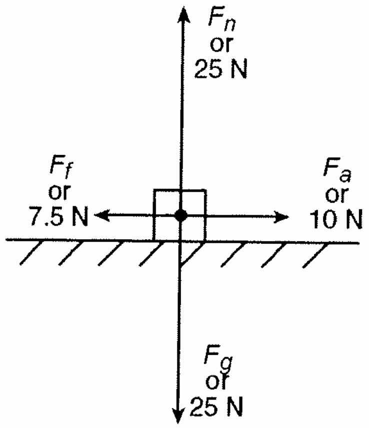
289) (a) 7.5 N

WORK SHOWN: $F_f = \mu F_N$, $F_f = (0.30)(25\text{ N})$, $F_f = 7.5$ N;

(b) 2.5 N;

(c) Yes

SAMPLE ANSWER: a net force is acting on it

290) 

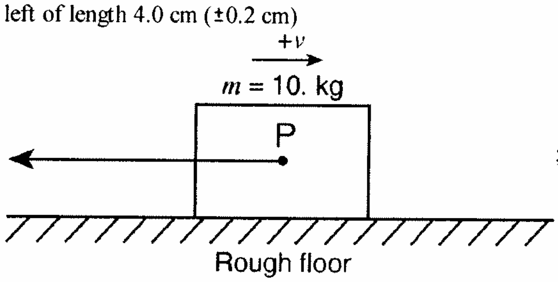
291) (a) 9.0 N (±0.6 N);
(b) 3.0 N;
(c) 0.75 m/s^2

WORK SHOWN: $a = \frac{F_{net}}{m} = \frac{3.0\text{ N}}{4.0\text{ kg}} = 0.75\text{ m/s}^2$ OR $a = \frac{F_1 - F_2}{m} = \frac{12.0\text{ N} - 9.0\text{ N}}{4.0\text{ kg}} = 0.75\text{ m/s}^2$

292) (a) -20. N OR 20 N

WORK SHOWN: $a = \frac{F_{net}}{m}$, $F_{net} = ma$, $F_{net} = (10.\text{ kg})(-2.0\text{ m/s}^2) = -20.\text{ N}$ OR 20 N;

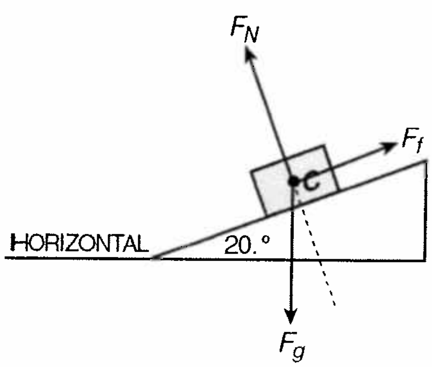
(b) vector directed to the left of length 4.0 cm (±0.2 cm)

SAMPLE ANSWER: 

;

(c) 0.20

WORK SHOWN: $F_f = \mu F_N$, $\mu = \frac{F_f}{F_N} = \frac{20.\text{ N}}{98.1\text{ N}} = 0.20$

293) 

294) $F_g = 98.1$ N OR $w = 98\ \frac{\text{kg}\cdot\text{m}}{\text{s}^2}$

WORK SHOWN: $g = \frac{F_g}{m}$, $F_g = mg$, $F_g = (10.0\text{ kg})(9.81\text{ m/s}^2)$, $F_g = 98.1$ N OR $w = mg$, $w = (10.0\text{ kg})(9.81\text{ m/s}^2)$, $w = 98\ \frac{\text{kg}\cdot\text{m}}{\text{s}^2}$

295) SAMPLE ANSWERS: The block would accelerate. OR The speed of the block would increase. OR The speed of the block would not be constant.

296) (a) 12,000 N OR 11,800 N;
(b) 8,000 N OR 8,040 N

WORK SHOWN: $F_f = \mu F_N$, $F_f = (0.67)(12{,}000\text{ N})$, $F_f = 8{,}000\text{ N}$ OR $8{,}040\text{ N}$;

(c) 1.3×10^5 J OR 128,000 J

WORK SHOWN: $W = Fd$, $W = (8{,}000\text{ N})(16\text{ m})$, $W = 1.3 \times 10^5\text{ J}$ OR 128,000 J;

(d) 15 m/s OR 14.6 m/s

WORK SHOWN: $W = KE = \frac{1}{2}mv^2$, $v = \sqrt{\frac{2KE}{m}}$, $v = \sqrt{\frac{2(1.3 \times 10^5\text{ J})}{1.2 \times 10^3\text{ kg}}} = 15\text{ m/s}$

OR $a = \frac{F_{net}}{m}$, $a = 6.7\text{ m/s}^2$, $v_f^2 = v_i^2 + 2ad$, $v_i = \sqrt{v_f^2 - 2ad}$, $v_i = \sqrt{0 - 2(-6.7\text{ m/s}^2)(16\text{ m})}$, $v_i = 14.6\text{ m/s}$

297) (a) 7.15 m/s^2;

(b) 8,940 N

WORK SHOWN: $F_t = \Delta p$, $F = \frac{m\Delta v}{t}$, $F = \frac{(1{,}250\text{ kg})(26.8\text{ m/s})}{3.75\text{ s}}$, $F = 8{,}930\text{ N}$ OR $F = ma$, $F = (1{,}250\text{ kg})(7.15\text{ m/s}^2)$, $F = 8{,}940\text{ N}$;

(c) 12,300 N;

(d) 9,800 N OR 9.8×10^3 N

WORK SHOWN: $F_f = \mu F_N$, $F_f = (0.80)(12{,}300\text{ N})$, $F_f = 9{,}800\text{ N}$ OR $9.8 \times 10^3\text{ N}$;

(e) SAMPLE ANSWERS: Yes. It is reasonable, because the available friction force is greater than the needed acceleration force. OR Yes. The friction force is greater. OR Yes. The accelerating force is less.

298) $6{,}000\ \frac{\text{kg}\cdot\text{m}}{\text{s}}$

299) SAMPLE ANSWERS: The force of the engines is equal in magnitude to the frictional drag force. OR They are equal. OR $F_f = F_{engine}$

300) (a) 10. m/s^2 OR 10. N/kg

WORK SHOWN: $a = \frac{F_{net}}{m}$, $a = \frac{5.0\text{ N}}{0.50\text{ kg}}$, $a = 10.\text{ m/s}^2$ OR 10. N/kg;

(b) 5.0 N OR -5.0 N

301) 0.50

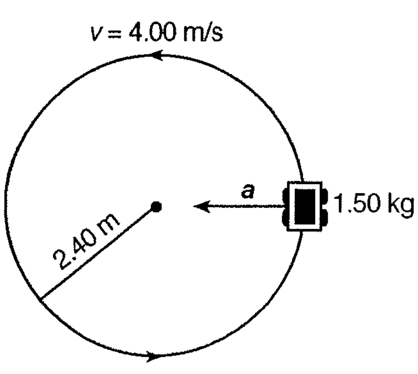
WORK SHOWN: $F_c = ma_c a_c = \frac{v^2}{r}$, $F_c = \frac{mv^2}{r} = \frac{(1{,}600\text{ kg})(20.\text{ m/s})^2}{80.\text{ m}} = 8.0 \times 10^3\text{ N}$, $F_N = mg = (1{,}600\text{ kg})(9.81\text{ m/s}^2) = 1.6 \times 10^4\text{ N}$, $F_f = F_c$, $F_f = \mu F_N$, $\mu = \frac{F_f}{F_N} = \frac{8.0 \times 10^3\text{ N}}{1.6 \times 10^4\text{ N}} = 0.50$

302) Changing the mass of the car would have no effect on the maximum speed at which it could round the curve.

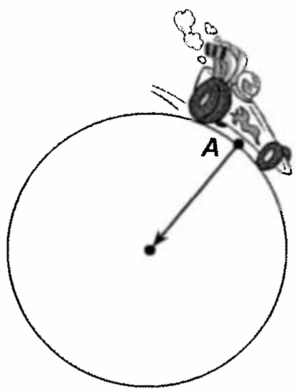
303) 3.77 s

WORK SHOWN: $v = \frac{d}{t}$, $t = \frac{d}{v}$, $t = \frac{2\pi r}{v}$, $t = \frac{2\pi(2.40\text{ m})}{4.0\text{ m/s}}$, $t = 3.77\text{ s}$ OR $\bar{v} = \frac{d}{t}$, $4.00\text{ m/s} = \frac{15.08\text{ m}}{t}$, $t = 3.77\text{ s}$

304) SAMPLE ANSWERS: double the speed of the car OR reduce the radius to 0.60 m OR quadruple the mass OR double the mass of the cart and halve the radius OR increase the speed of the cart to 5.66 m/s and double the mass of the cart OR increase the speed of the cart to 5.66 m/s and halve the radius

305) 

306) SAMPLE ANSWER:



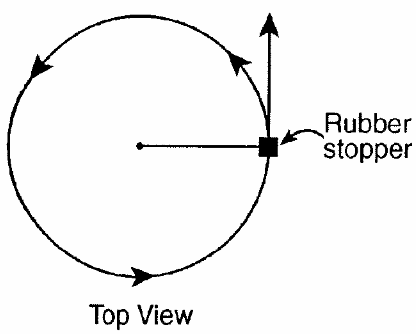
307) (a) 28 m/s OR 27.9 m/s

WORK SHOWN: $\bar{v} = \frac{d}{t}$, $\bar{v} = \frac{2\pi r}{t}$, $\bar{v} = \frac{2\pi(160\text{ m})}{36\text{ s}}$ = 28 m/s OR 27.9 m/s;

(b) 4.9 m/s^2

WORK SHOWN: $a_c = \frac{v^2}{r}$, $a_c = \frac{(28\text{ m/s})^2}{160\text{ m}} = 4.9\text{ m/s}^2$

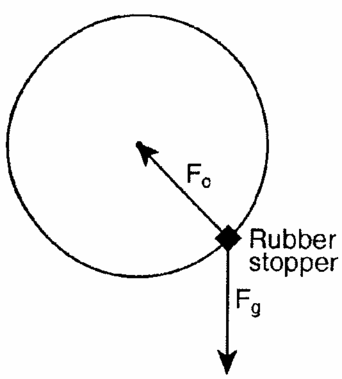
308)



309) SAMPLE ANSWERS: As the speed of the stopper is increased, the radius of the orbit will increase. OR The radius gets bigger or gets larger. OR R gets bigger OR increases

310) SAMPLE ANSWERS: mass of stopper OR radius of path OR velocity of stopper (or frequency or period) OR weight of the balancing weights

311)



312) SAMPLE ANSWER 1: freefall: (a) object, meterstick, stopwatch, (b) time of fall, distance of fall, (c) drop object from measured height, time its fall, (d) $d = v_i t + \frac{1}{2}at^2$;

SAMPLE ANSWER 2: pendulum: (a) string, mass, stopwatch, meterstick, (b) length of pendulum, period, (c) measure length of pendulum, period of pendulum, (d) $T = 2\pi\sqrt{\frac{l}{g}}$;

SAMPLE ANSWER 3: spring scale: (a) spring scale, known mass; (b) weight on Moon of known mass, (c) hang the weight on the spring scale and weigh it, (4) $F_{gM} = mg_M$, $\frac{F_{gM}}{F_{gE}} = \frac{g_M}{g_E}$

313) 1.99×10^{30} kg

WORK SHOWN: $F = G\frac{m_1 m_2}{r^2}$, $m_2 = \frac{Fr^2}{Gm_1}$,

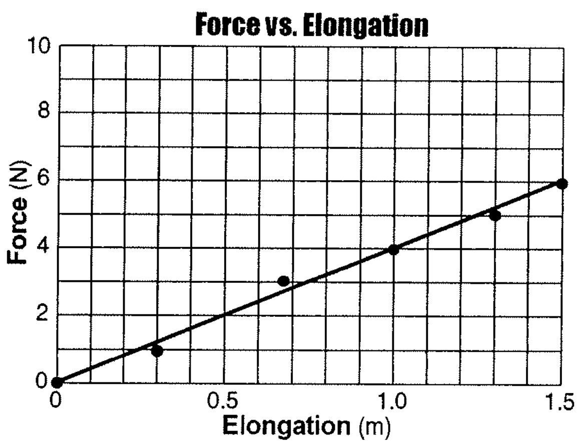
$$m_2 = \frac{(3.52 \times 10^{22}\ \text{N})(1.50 \times 10^{11}\ \text{m})^2}{(6.67 \times 10^{-11}\frac{\text{N}\cdot\text{m}^2}{\text{kg}^2})(5.98 \times 10^{24}\ \text{kg})} = 1.99 \times 10^{30}\ \text{kg}$$

314) SAMPLE ANSWER: Gravity is the fundamental force to which the author is referring.

315) 2.26×10^{17} N

WORK SHOWN: $F = \frac{Gm_1 m_2}{r^2}$, $F = \frac{(6.67 \times 10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2)(8.73 \times 10^{25}\ \text{kg})(1.03 \times 10^{26}\ \text{kg})}{(1.63 \times 10^{12}\ \text{m})^2} = 2.26 \times 10^{17}$ N

316) SAMPLE ANSWER: The Sun is larger in mass.

317) (a&b) 

;

(b) 4.0 N/m

WORK SHOWN: k = slope, $k = \frac{\Delta F}{\Delta x}$, $k = \frac{4.0\ \text{N} - 2.0\ \text{N}}{1.0\ \text{m} - 0.5\ \text{m}} = 4.0$ N/m

318) B

319) A

320) C

321) D

322) A

323) A

324) C

325) A

326) D

327) C

328) A

329) C

330) C

331) D

332) B

333) C

334) D

335) C

336) B

337) B

338) D

339) C

340) D

341) B

342) A

343) B

344) C

345) D

346) D

347) A

348) A

349) C

350) B

351) 5.22×10^5 J/C OR 5.22×10^5 V

WORK SHOWN: $V = \frac{W}{q}$, $V = \frac{8.35 \times 10^{-14}\ J}{1.60 \times 10^{-19}\ C}$, $V = 5.22 \times 10^5$ J/C OR 5.22×10^5 V

352) B

353) C

354) C

355) A

356) A

357) B

358) C

359) B

360) C

361) C

362) B

363) B

364) C

365) A

366) D

367) D

368) D

369) B

370) A

371) D

372) C

373) D

374) A

375) A

376) C

377) A

378) A

379) B

380) D

381) D

382) A

383) B

384) C

385) A

386) D

387) C

388) C

389) C

390) B

391) C

392) C

393) A

394) A

395) B

396) D

397) C

398) A

399) B

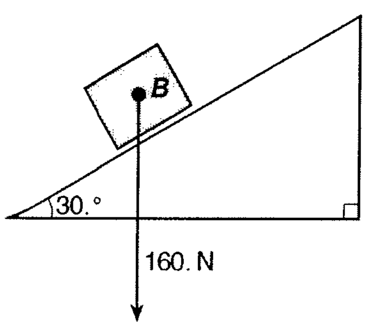
400) C

401) C

402) D

403) D

404) B

405) 

406) 800 J
WORK SHOWN: $F_y = F \sin\theta$ and $w = Fd$, $F_y = (160.\ \text{N})(\sin 30.°) = 80.\ \text{N}$, $w = (80.\ \text{N})(10.\ \text{m}) = 800\ \text{J}$
OR
$w = Fd\sin\theta$, $w = (160.\ \text{N})(10.\ \text{m})(\sin 30.°)$, $w = 800\ \text{J}$
OR
$w = Fd = \Delta E_T = mgh$ and $h = d\sin\theta$, $w = mgd\sin\theta$,
$w = (160.\ \text{N})(10.\ \text{m})(\sin 30.°)$, $w = 800\ \text{J}$

407) (a) 5.0 m/s

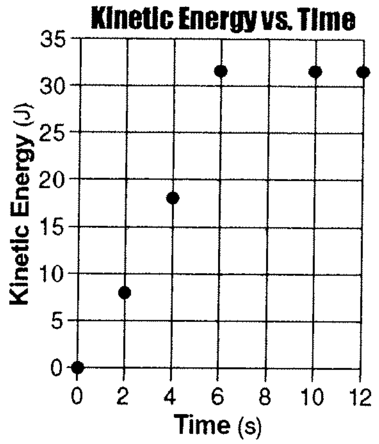
WORK SHOWN: $P_{before} = P_{after}$ OR $m_{before}v_{before} = m_{after}v_{after}$, (50. kg)(6.0 m/s) = (60. kg)v_{after}, $v_{after} = \frac{(50.\ kg)(6.0\ m/s)}{(60.\ kg)}$ = 5.0 m/s;

(b) 750 J

WORK SHOWN: $KE = \frac{1}{2}mv^2$, $KE = \frac{1}{2}$(60. kg)(5.0 m/s)^2 = 750 J;

(c) 750 J

408)



409) (a) 4.0 m/s OR $4.0\sqrt{\frac{J}{kg}}$

WORK SHOWN: $KE = \frac{1}{2}mv^2$, $v = \sqrt{\frac{2KE}{m}}$, $v = \sqrt{\frac{2(32\ J)}{4.0\ kg}} = \sqrt{\frac{16\ m^2)}{s^2}}$ = 4.0 m/s or $4.0\sqrt{\frac{J}{kg}}$;

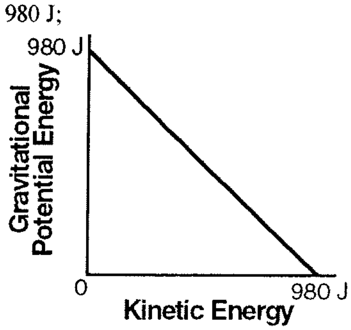
(b) SAMPLE ANSWERS: The speeds are the same. OR The speed of the mass at 6.0 seconds and the speed of the mass at 10.0 seconds are both 4.0 m/s.

410) (a) 980 J OR 9.8×10^2 kg•m^2/s^2

WORK SHOWN: $\Delta PE = mg\Delta h$, ΔPE = (20. kg)(9.8 m/s^2)(5.0 m), ΔPE = 980 J OR $\Delta PE = 9.8 \times 10^2$ kg•m^2/s^2;

(b) 980 J;

(c)



411) (a) 1.0 m/s

WORK SHOWN: $P_{before} = P_{after}$, $m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v_f$, (1,000. kg)(6.0 m/s) + (5,000. kg)(0.0 m/s) = (1,000. kg + 5,000. kg)v_f, 6,000 kg•m/s = (6,000. kg)v_f, v_f = 1.0 m/s;

(b) 3,000 J OR 3.0×10^3 J

WORK SHOWN: $KE = \frac{1}{2}mv^2 = \frac{1}{2}$(6,000. kg)(1.0 m/s)^2 = 3,000 J or 3.0×10^3 J

412) SAMPLE ANSWERS: The *KE* of the combined carts after the collision is less than the *KE* of the carts before the collision. OR less OR $KE_{before} > KE_{after}$

413) (a) 6.4×10^4 J

WORK SHOWN: $\Delta PE = mg\Delta h$, $\Delta PE = (250.\text{ kg} + 75\text{ kg})(9.81\text{ m/s}^2)(20.\text{ m}) = 6.4 \times 10^4\text{ J}$;

(b) 20. m/s

WORK SHOWN: $\Delta PE = KE = \frac{1}{2}mv^2$, $v = \sqrt{\frac{2\Delta PE}{m}}$, $v = \sqrt{\frac{2(6.4 \times 10^4\text{ J})}{325\text{ kg}}} = 20.\text{ m/s}$ OR $\Delta PE = KE = \frac{1}{2}mv^2$, $6.4 \times 10^4\text{ J} = \frac{1}{2}(250.\text{ kg} + 75\text{ kg})v^2$, $v^2 = 394$, $v = 20.\text{ m/s}$

414) The total mechanical energy is the same at all three points.

415) 88 J OR 88.3 $\text{kg}\cdot\text{m}^2/\text{s}^2$

WORK SHOWN: $\Delta PE = mg\Delta h$, $\Delta PE = (3.0\text{ kg})(9.81\text{ m/s}^2)(3.0\text{ m}) = 88\text{ J}$ OR $88.3\text{ kg}\cdot\text{m}^2/\text{s}^2$

416) 59 J OR 58.9 J

WORK SHOWN: $E_T = PE + KE + Q$, $KE = mg\Delta h$, $KE = (3.0\text{ kg})(9.81\text{ m/s}^2)(3.0\text{ m} - 1.0\text{ m}) = 59\text{ J}$ OR 58.9 J

417) *G*

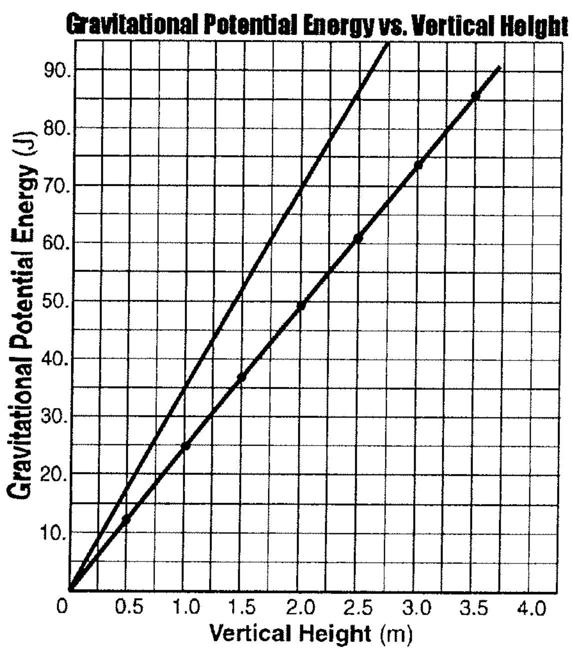
418) (a) 55 J;

(b) 2.5 kg OR 2.55 kg

WORK SHOWN: $PE = mgh$, $m = \frac{PE}{gh}$, $m = \frac{25\text{ J}}{(9.81\text{ m/s}^2)(1.0\text{ m})}$, $m = 2.5$ kg or 2.55 kg OR $PE = mgh$, $m = \frac{55\text{ J}}{(2.25\text{ m})(9.81\text{ m/s}^2)}$, $m = 2.5$ kg

419) SAMPLE ANSWERS: weight of object OR weight OR mg OR force OR F_g

420)

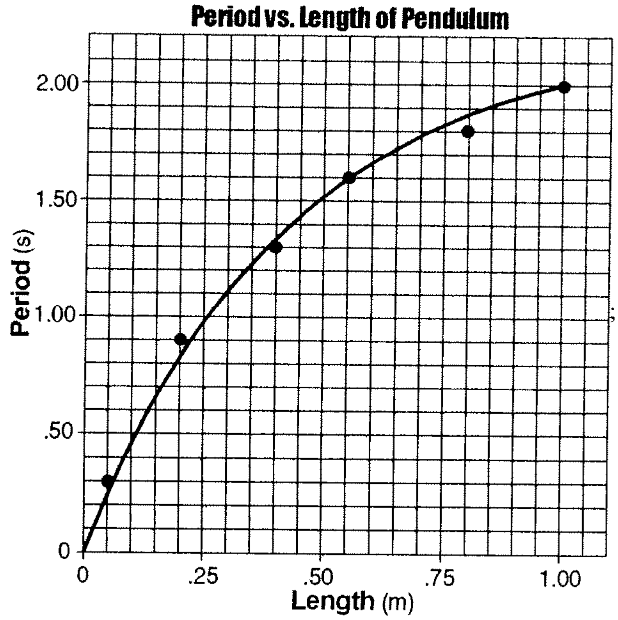


421) 1.60 s OR 1.6 second

422) The slope of each line is the spring constant.

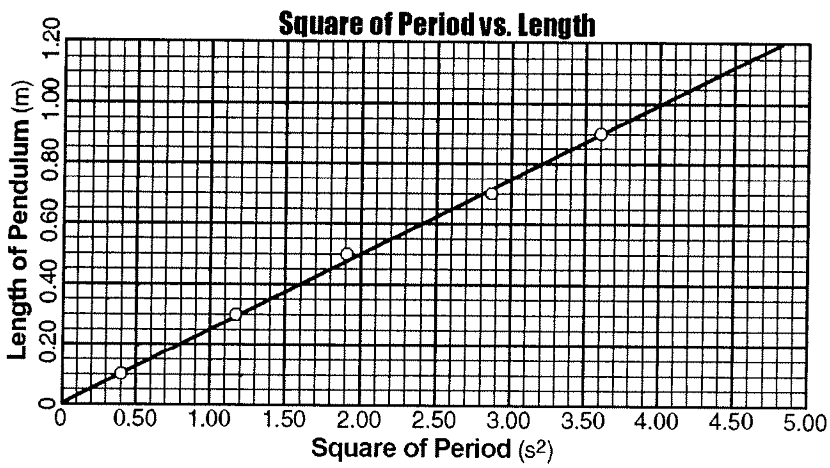
423) SAMPLE ANSWERS: The potential energy stored in spring *A* is less than the potential energy stored in spring *B*. OR less OR The potential energy stored... in spring *A* is less. OR ...in spring *B* is more.

424) (a-c)



; (d) 1.0 s (±0.03 s)

425) (a-b)



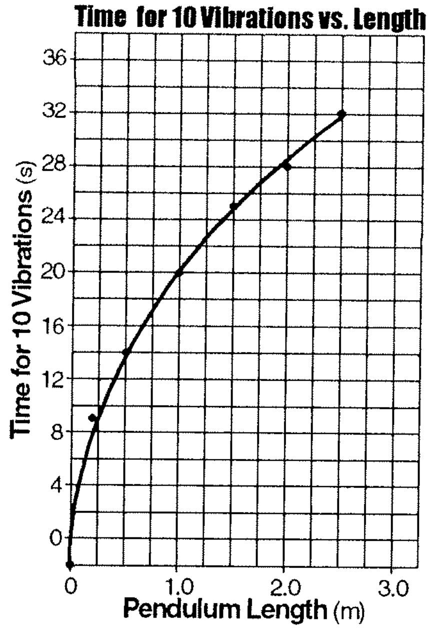
;

(c) 0.89 (±0.1) seconds;

(d) SAMPLE ANSWERS: Find the coordinates of a point on the best-fit line and substitute into $T^2 = \frac{4\pi^2 \ell}{g}$ and solve for g. OR Find the slope and divide it into $4\pi^2$.

426) *R*, *U*, *Y*

427) *W*, *X*, *Z*

428) 

429) 2.0 s OR 2 seconds

430) SAMPLE ANSWERS: The kinetic energy of the system is greatest at position *B*. *B*, because the mass has the greatest speed. OR *B*, because the total potential energy is least. OR *B*, the speed at *A* and *C* is zero.

431) SAMPLE ANSWERS: The gravitational potential energy of the system is at a maximum at position *A*. OR *A*, because it is the highest point of travel.

432) SAMPLE ANSWERS: The elastic potential energy of the system is a maximum at position *C*. OR *C*, because the spring is stretched the maximum amount. OR *C*, because the KE and gravitational PE are a minimum.

433) SAMPLE ANSWERS: Position *A*: kinetic OR *KE* OR energy of motion; Position *B*: elastic OR potential OR energy of position

434) $mg\Delta h = \frac{1}{2}kx^2$ OR $\Delta PE = PE_s$, $k = \frac{2mg\Delta h}{x^2}$

WORK SHOWN: $\Delta PE = mg\Delta h$, $PE_s = \frac{1}{2}kx^2$, $\frac{1}{2}kx^2 = mg\Delta h$, $k = \frac{2mg\Delta h}{x^2}$

435) SAMPLE ANSWERS: work into OR potential energy (spring) into OR kinetic energy into OR potential energy (gravity)

436) SAMPLE ANSWERS: The toy has less mass without the base but the same energy. Therefore it can go higher. OR The work put into the toy is the same but the mass is less. With less mass the toy could go higher because it is moving faster.

437) (a) 2,380 N • m OR 2,400 J

WORK SHOWN: $W = F\Delta s$, $W = (680\text{ N})(3.5\text{ m})$, $W = 2{,}380\text{ N}\cdot\text{m}$;

(b) 210 W OR 208.8 J/s

WORK SHOWN: $P = \frac{W}{\Delta t}$, $P = \frac{2{,}400\text{ J}}{11.4\text{ s}}$, $P = 210$ W OR $P = \frac{W}{t}$, $P = \frac{2{,}380\text{ J}}{11.4\text{ s}}$, $P = 208.8$ J/s;

(c) SAMPLE ANSWERS: The power developed during the 11.4-second trial is less than the power developed during the 8.5-second trial. OR The power developed during the 11.4-second trial is less.

438) (a) 8.0 m (±0.2 m);

(b) 130 W OR 133 W

WORK SHOWN: $P = \frac{Fd}{t}$, $P = \frac{(50.\text{ N})(8.0\text{ m})}{3.0\text{ s}} = 130$ W OR 133 W

439) C