

1. 1.80 / 12.4 25

$$a_c = 0.26 \text{ m/s}^2 \quad F_c = 6.5 \text{ N}$$

$$a_c = \frac{v^2}{r} = \frac{(1.8)^2}{12.4} = 0.26 \text{ m/s}^2$$

$$F_c = \frac{mv^2}{r} = 25(0.26) = 6.5 \text{ N}$$

Feb 25-10:48 AM

2. 500 / 3.00 ?

$$a_c = 167 \text{ m/s}^2 \quad g's = 17$$

$$a_c = \frac{v^2}{r} = \frac{500^2}{1500} = 167 \text{ m/s}^2$$

$$g = \frac{167}{9.8} = 17 \text{ g's}$$

Feb 25-11:05 AM

3. 26.0 0.60 0.40

$$v = 4.2 \text{ m/s}$$

$$F_c = \frac{mv^2}{r} \quad 26 = \frac{0.6 v^2}{0.4}$$

$$v^2 = \frac{26(0.4)}{0.6}$$

$$v = 4.2 \text{ m/s}$$

Feb 25-11:05 AM

4. 0.55? 1500 95

$$v = 22.6 \text{ m/s}$$

$$F_g = ma_g = 1500(9.8) = 14700 \text{ N}$$

$$F_N = F_g \cos \theta = 14700 \cos 0^\circ = 14700 \text{ N}$$

$$\mu = \frac{F_f}{F_N} \quad 0.55 = \frac{F_f}{14700} \quad F_f = 8085$$

$$F_f = F_c$$

$$F_c = \frac{mv^2}{r} \quad 8085 = \frac{1500 v^2}{95}$$

$$v^2 = \frac{8085(95)}{1500}$$

$$v = 22.6 \text{ m/s}$$

Feb 25-11:06 AM

5. 800 62 15 / .

$$\mu = 0.37$$

$$F_c = \frac{mv^2}{r} = \frac{800(15)^2}{62} = 2903 \text{ N} = F_f$$

$$F_g = ma_g = 800(9.8) = 7840 \text{ N}$$

$$F_N = F_g \cos \theta = 7840 \cos 0^\circ = 7840 \text{ N}$$

$$\mu = \frac{F_f}{F_N} \quad \mu = \frac{2903}{7840}$$

$$\mu = 0.37$$

Feb 25-11:06 AM

6. 1500 85 4.0

$$v = 5.6 \text{ m/s}$$

$$F_g = ma_g = 85(9.8) = 833 \text{ N}$$

$$F_c = 1500 - F_g = 1500 - 833 = 667 \text{ N}$$

$$F_c = \frac{mv^2}{r} \quad 667 = \frac{85v^2}{4}$$

$$v^2 = \frac{667(4)}{85}$$

$$v = 5.6 \text{ m/s}$$

Feb 25-11:06 AM

7. 1.0

$$v = 3.1 \text{ m/s}$$

$$a_c = \frac{v^2}{r} \quad 9.8 = \frac{v^2}{1}$$

$$v^2 = 9.8$$

$$v = 3.1 \text{ m/s}$$

Feb 25-11:08 AM

8. 6400 (9.8) 6 \cdot 10^{10} \text{ kg}

$$a_{\text{net}} = 9.766 \text{ m/s}^2 \quad a_c = 0.034 \text{ m/s}^2$$

$$v = \frac{d}{t} \quad v = \frac{c}{t} \quad v = \frac{2\pi r}{t}$$

$$v = 2(3.14)(6.4 \cdot 10^6) / (2\pi(80)(2\pi))$$

$$v = 465 \text{ m/s}$$

$$a_c = \frac{v^2}{r} = \frac{(465)^2}{6.4 \cdot 10^6} \quad a_c = 0.034 \text{ m/s}^2$$

$$a_{\text{net}} = 9.8 - 0.034$$

$$a_{\text{net}} = 9.766 \text{ m/s}^2$$

Feb 25-11:09 AM

9. 8.0 ?

$$v > 8.9 \text{ m/s}$$

$$a_c = \frac{v^2}{r} \quad 9.8 = \frac{v^2}{8}$$

$$v^2 = 9.8(8)$$

$$v > 8.9 \text{ m/s}$$

Feb 25-11:10 AM

10. 6400) 600 . (

$$v > 7578 \text{ m/s}$$

$$F_g = \frac{Gm_1m_2}{d^2} \quad F_c = \frac{mv^2}{r}$$

$$\frac{Gm_E m_E}{r^2} = \frac{m_E v^2}{r}$$

$$Gm_E = v^2$$

$$\frac{(6.7 \cdot 10^{-11})(6 \cdot 10^{24})}{(7 \cdot 10^6)^2} = v^2$$

$$v > 7578 \text{ m/s}$$

$r = 600 + 6400$
 $r = 7000 \text{ km}$

Feb 25-11:13 AM

11. 200

$$a_c = 9.2 \text{ m/s}^2$$

$$F_c = \frac{mv^2}{r} \quad F_g = \frac{Gm_1m_2}{d^2}$$

$$\frac{m v^2}{r} = \frac{G m_E m_E}{r^2}$$

$$a_c = \frac{v^2}{r} = \frac{G m_E}{r^2}$$

$$a_c = \frac{G m_E}{r^2}$$

$$a_c = \frac{(6.7 \cdot 10^{-11})(6 \cdot 10^{24})}{(6.6 \cdot 10^6)^2}$$

$$a_c = 9.2 \text{ m/s}^2$$

$r = 6400 + 200$
 $r = 6600 \text{ km}$

Feb 25-11:18 AM

12. 7.5 / ?

$$alt = 920 \text{ km}$$

$$a_c = \frac{G m_E}{r^2}$$

$$7.5 = \frac{(6.7 \cdot 10^{-11})(6 \cdot 10^{24})}{r^2}$$

$$r^2 = \frac{(6.7 \cdot 10^{-11})(6 \cdot 10^{24})}{7.5}$$

$$r = 7.32 \cdot 10^6 \text{ m}$$

$$= 7320 \text{ km}$$

$$alt = 7320 - 6400$$

$$alt = 920 \text{ km}$$

Feb 25-11:19 AM

13. 50 50 100
? ?

$v = 18.8 \text{ m/s}$ $v = 15.7 \text{ m/s}$
horizontal vertical

$$F_c = \frac{mv^2}{r} \quad 50 = \frac{(0.1)v^2}{0.5}$$

$$v^2 = \frac{50(0.5)}{0.1}$$

$$v = 15.8 \text{ m/s}$$

$F_g = mcg$
 $= (0.1)(9.8) = 0.98 \text{ N}$

$$F_c = 50 - 0.98 = 49 \text{ N}$$

$$F_c = \frac{mv^2}{r} \quad 49 = \frac{0.1v^2}{0.5}$$

$$v^2 = \frac{49(0.5)}{0.1}$$

$$v = 15.7 \text{ m/s}$$

Feb 25-11:19 AM

14. 8.0 / ? 3.0 0.5

$$F_c = 384 \text{ N}$$

$$F_c = \frac{mv^2}{r} = \frac{3(8)^2}{0.5}$$

$$F_c = 384 \text{ N}$$

Feb 25-11:20 AM

15. 500 ?

$$v = 70 \text{ m/s}$$

$$a_c = \frac{v^2}{r} \quad 9.8 = \frac{v^2}{500}$$

$$v^2 = 500(9.8)$$

$$v = 70 \text{ m/s}$$

Feb 25-11:20 AM

16. 300 70 40

$$v = 9.7 \text{ m/s}$$

$$F_c = \frac{mv^2}{r} \quad 40 = \frac{0.3v^2}{0.7}$$

$$v^2 = \frac{40(0.7)}{0.3}$$

$$v = 9.7 \text{ m/s}$$

Feb 25-11:21 AM

17. 1000 30 / . 0.25

$$r = 367 \text{ m}$$

$$F_g = ma_g = 1000(9.8) = 9800 \text{ N}$$

$$F_N = F_g \cos \theta = 9800 \cos 0^\circ = 9800 \text{ N}$$

$$\mu = \frac{F_f}{F_N} \quad 0.25 = \frac{F_f}{9800} \quad F_f = 2450 \text{ N} = F_c$$

$$F_c = \frac{mv^2}{r} \quad 2450 = \frac{1000(30)^2}{r}$$

$$r = \frac{1000(30)^2}{2450}$$

$$r = 367 \text{ m}$$

Feb 25-11:21 AM

18. 20.0 10 0.3 33

since $F_f > F_c$ it stays $F_f = 0.0588 \text{ N}$
 $F_c = 0.024 \text{ N}$

$$F_g = ma_g = 0.02(9.8) = 0.196 \text{ N}$$

$$F_N = F_g \cos \theta = 0.196 \cos 0^\circ = 0.196 \text{ N}$$

$$\mu = \frac{F_f}{F_N} \quad 0.3 = \frac{F_f}{0.196} \quad F_f = 0.0588 \text{ N}$$

the centripetal force needed would be:

$$v = \frac{d}{t} \quad v = \frac{2\pi r(33.3)}{60} = \frac{2(3.14)(0.1)(33.3)}{60}$$

$$v = 0.349 \text{ m/s}$$

$$F_c = \frac{mv^2}{r} \quad F_c = \frac{(0.02)(0.349)^2}{0.1}$$

$$F_c = 0.024 \text{ N}$$

~~since $F_f > F_c$ it stays~~

Feb 25-11:22 AM

19. 15.0 / . 20.0 40 .

$$\mu = 0.57$$

$$F_c = \frac{mv^2}{r} = \frac{(0.02)(15)^2}{40} \quad F_c = 0.1125 \text{ N} = F_f$$

$$F_g = ma_g = (0.02)(9.8) = 0.196 \text{ N}$$

$$F_N = F_g \cos \theta = 0.196 \cos 0^\circ = 0.196 \text{ N}$$

$$\mu = \frac{F_f}{F_N} \quad \mu = \frac{0.1125}{0.196} \quad \mu = 0.57$$

Feb 25-11:22 AM

20.

$$v = 7920 \text{ m/s}$$

$$a_c = \frac{v^2}{r} \quad \text{at sea level } a_c = a_g$$

$$9.8 = \frac{v^2}{6.4 \cdot 10^6} \quad v^2 = (9.8)(6.4 \cdot 10^6)$$

$$v = 7920 \text{ m/s}$$

Feb 25-11:23 AM

21. 50.0 30. 50.0

$v = 1.2 \text{ m/s}$

$F_R = F_T + F_g = F_c$

$r = 50 \sin 30^\circ$
 $r = 25 \text{ cm}$

$F_g = (0.05)(9.8) = 0.49 \text{ N}$
 $F_c = F_g \tan \theta = 0.49 \tan 30^\circ = 0.28 \text{ N}$

$F_c = \frac{mv^2}{r}$
 $0.28 = \frac{0.05 v^2}{0.25}$
 $v^2 = \frac{0.28(0.25)}{0.05}$
 $v = 1.2 \text{ m/s}$

Feb 25-11:24 AM

22. 10,000 384,000 ? 7 · 10²² kg

$x = 37500 \text{ km from moon}$

$F_{gm} = \frac{Gm_1m_2}{d^2}$ $F_{gE} = \frac{Gm_1m_2}{d^2}$

$\frac{m_m}{x^2} = \frac{m_E}{(384,000 - x)^2}$

$\sqrt{\frac{7 \cdot 10^{22}}{x^2}} = \frac{6 \cdot 10^{24}}{(384,000 - x)^2}$

$\frac{2.65 \cdot 10^{11}}{x} = \frac{2.45 \cdot 10^{12}}{384,000 - x}$

$2.65 \cdot 10^{11} (384,000 - x) = 2.45 \cdot 10^{12} x$
 $1.018 \cdot 10^{17} - 2.65 \cdot 10^{11} x = 2.45 \cdot 10^{12} x$
 $1.018 \cdot 10^{17} = 2.715 \cdot 10^{12} x$
 $x = 37500 \text{ km from moon}$

Feb 25-11:24 AM

23. 7 · 10²² kg 200 1740

$v = 1555 \text{ m/s}$

$F_c = \frac{mv^2}{r} = F_g = \frac{Gm_1m_2}{d^2}$

$v^2 = \frac{Gm_1m_2}{r}$
 $v^2 = \frac{(6.7 \cdot 10^{-11})(7 \cdot 10^{22})}{1.94 \cdot 10^6}$
 $v = 1555 \text{ m/s}$

Feb 25-11:24 AM

24. 80

$a_g = 1.5 \text{ m/s}^2$

$F_c = \frac{mv^2}{r}$ $F_g = \frac{Gm_1m_2}{d^2}$

$a_g = \frac{Gm_m}{d^2} = \frac{(6.7 \cdot 10^{-11})(7 \cdot 10^{22})}{(1.78 \cdot 10^9)^2}$
 $a_g = 1.5 \text{ m/s}^2$

Feb 25-11:45 AM

25. 318 2 · 10³⁰ kg 11.86

$$r = 7.8 \cdot 10^8 \text{ m}$$

$$F_g = \frac{Gm_1m_2}{d^2} \quad F_c = \frac{mv^2}{r}$$

$$\frac{Gm_s}{r^2} = \frac{v^2}{r^2} \quad v = \frac{2\pi r}{t}$$

$$\frac{Gm_s}{r} = v^2$$

$$\frac{Gm_s}{r} = \left(\frac{2\pi r}{t}\right)^2$$

$$\frac{Gm_s}{r} = \frac{4\pi^2 r^2}{t^2}$$

$$\frac{Gm_s t^2}{4\pi^2} = r^3$$

$$\frac{(6.7 \cdot 10^{-11})(2 \cdot 10^{30})(11.86)(365)(24)(3600)^2}{4(3.14)^2} = r^3$$

$$4.75 \cdot 10^{35} = r^3$$

$$r = 7.8 \cdot 10^{11} \text{ km}$$

$$r = 7.8 \cdot 10^8 \text{ m}$$

Feb 25-11:45 AM

26. 30 60 30 ?

$v = 1.84 \text{ m/s}$

$F_g = ma_g = (0.03)(9.8) = 0.294 \text{ N}$
 $F_c = F_g \tan \theta = 0.294 \tan \theta = 0.170 \text{ N}$

$$F_c = \frac{mv^2}{r} \quad 0.170 = \frac{(0.03)v^2}{0.03}$$

$$v^2 = \frac{(0.170)(0.03)}{0.03}$$

$$v = 1.3 \text{ m/s}$$

Feb 25-11:47 AM

27. #21. 4.50 / .

$\theta = 77^\circ$

$r = 0.5 \sin \theta$
 $F_g = 0.05(9.8)$
 $F_g = 0.49$
 $F_c = 0.49 \tan \theta$

$$F_c = \frac{mv^2}{r} = \frac{(0.05)(45)^2}{0.5 \sin \theta}$$

$$F_c = \frac{2.025}{\sin \theta}$$

$$\frac{2.025}{\sin \theta} = 0.49 \tan \theta$$

$$2.025 = 0.49 \sin \theta \tan \theta$$

$$4.133 = \sin \theta \tan \theta$$

$$4.133 = \frac{\sin \theta \sin \theta}{\cos \theta}$$

$$4.13 = \frac{\sin^2 \theta}{\cos \theta}$$

$$4.13 \sqrt{1 - \sin^2 \theta} = \sin^2 \theta$$

$$17.1(1 - \sin^2 \theta) = \sin^2 \theta$$

$$17.1 - 17.1 \sin^2 \theta = \sin^2 \theta$$

$$0 = \sin^2 \theta + 17.1 \sin^2 \theta - 17.1$$

$$\sin^2 \theta = \frac{-(17.1) \pm \sqrt{(17.1)^2 - 4(1)(-17.1)}}{2(1)}$$

$$\sin^2 \theta = \frac{-17.1 \pm 19.0}{2}$$

$$\sin^2 \theta = \frac{1.9}{2}$$

$$\sin^2 \theta = 0.95$$

$$\sin \theta = 0.975$$

$$\theta = 77^\circ$$

Feb 25-11:47 AM

28. 20.0 / . 1000 50.0

$\theta = 39^\circ$

$$F_c = \frac{mv^2}{r} = \frac{1000(20)^2}{50} = 8000 \text{ N}$$

$$F_g = ma_g = 1000(9.8) = 9800 \text{ N}$$

$$\tan \theta = \frac{F_c}{F_g} = \frac{8000}{9800} = 0.816$$

$$\theta = 39^\circ$$

Feb 25-11:48 AM

29. 384,000

$t = 27.3 \text{ days}$

$$F_c = \frac{mv^2}{r} \quad F_g = \frac{Gm_1m_2}{d^2}$$

$$v^2 = \frac{Gm_1}{r} \quad v = \frac{2\pi r}{t}$$

$$\frac{4\pi^2 r^2}{t^2} = \frac{Gm_1}{r}$$

$$\frac{4\pi^2 r^3}{Gm_1} = t^2$$

$$\frac{4(3.14)^2(3.84 \cdot 10^8)^3}{(6.7 \cdot 10^{-11})(6 \cdot 10^{24})} = t^2$$

$$5.55 \cdot 10^{12} = t^2$$

$$t = 2.36 \cdot 10^6 \text{ sec}$$

$$t = \frac{2.36 \cdot 10^6}{(24)(3600)}$$

$$t = 27.3 \text{ days}$$

Feb 25-11:49 AM

30. Tarzan, mass 80 kg, swings from a 3.0 m rope that makes a 37° with vertical. Find the tension in the rope at the bottom of the swing.

$F_T = 1092 \text{ N}$

$x = 3.0 \cos 37^\circ$
 $x = 2.4 \text{ m}$
 $h = 3.0 - 2.4$
 $h = 0.6 \text{ m}$

$E_{P.E.} = (80)(9.8)(0.6)$
 $E_{P.E.} = 470 \text{ J}$
 $E_{P.E.} = m a_g h$
 $E_{P.E.} = E_{K.E.}$
 $470 = (1/2)(80)v^2$
 $470(2)/80 = v^2$
 $11.75 = v^2$
 $v = 3.4 \text{ m/s}$

$$F_c = \frac{mv^2}{r}$$

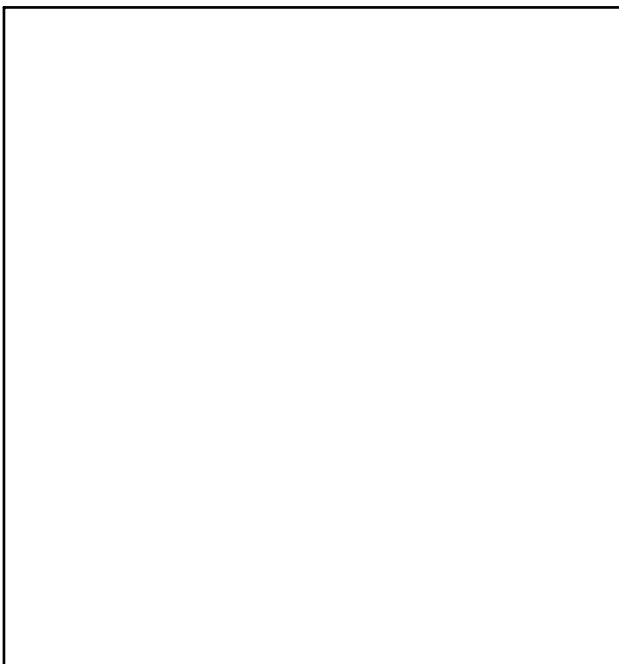
$$F_c = (80)(3.4)^2/3$$

$$F_c = 308 \text{ N}$$

$F_T = 308 + 784$
 $F_T = 1092 \text{ N}$

$F_g = m a_g$
 $F_g = (80)(9.8)$
 $F_g = 784 \text{ N}$

Feb 25-3:13 PM



Feb 16-9:24 AM