2004 BR

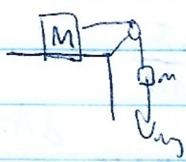
MCM 14, 20, 23, 25, 30, 32, 33, 34, 35

E 2/37, 3/38, 15/50, 16/51, 17/52

24/59, 25/60, 32/67, 35/70

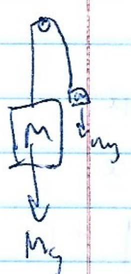
14) (b) d

20)



~~$mg = (M+m)a$~~

$a = \frac{m}{M+m} g$



$Mg - mg = (M+m)a$

$a = \frac{M-m}{M+m} g$ (e) +1

23) ρ is constant $3+4=7$ (d) c

25) (b) c

30) $P = \frac{W}{t}$ $W = Pt$

$= 1{,}000\ J$

$mgh = 1{,}000\ J$

$(100\ kg)(10\ m/s^2)\ h = 1000\ J$

$h = 1\ m$ (a) c

32) (d) +1 33) (c) +1 34) centripetal

(a) +1

35) $\frac{G M m}{r} = \frac{1}{2} m v_e^2$

$v_e = \sqrt{\frac{2GM}{r}}$ (b) +1

+5 B, M

2(37) $V = IR$

$P = I^2 R = \frac{V^2}{R}$

$I = \frac{V}{R}$

$P = \frac{V^2}{R^2} \cdot R = \frac{V^2}{R}$

~~$R = \frac{P}{V^2}$~~

~~$= (1200\ W)(120\ V)^2$~~

$R = \frac{V^2}{P} = \frac{120^2}{1200} = 12\ \Omega$

(c) +1

3/38) (a) gauss' law +1

15/50) $\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}$ (c) +1

16/51) $\mathcal{E} = B \pi a^2 t^2 \left(\frac{d}{dt}\right)$

$= 2 B \pi a^2 t$ (a) +1

17/52) ? (e) c

24/59) (a) +1 high to low V

25/60) (b) +1 32/67) (e) a

35/70) (b) +1

+7 B, E

14) d 23) c 25) c 30) c +4 M, R

17/52) c 25/60) a +2 R, E

FRM

2) d) the effective radius of the pulley was larger than expected b/c the string was wrapped around, and the string also increased the mass. +2

3) a) +4 BL (see orig.)

3) b) $\frac{1}{6} mgL = \frac{1}{2} I \omega^2 = \frac{1}{2} I \cdot \frac{v_{cm}^2}{(\frac{1}{6}L)^2}$

$\frac{1}{6} mgL = \frac{1}{2}\left(\frac{1}{9} M L^2\right) \cdot \frac{36 v_{cm}^2}{L^2}$

$\frac{1}{6} mgl = 2 m v_{cm}^2$

$v_{cm} = \sqrt{\frac{gl}{12}}$

$\omega = \frac{v}{R} = \sqrt{\frac{gl}{12}} \cdot \frac{6}{l}$

$= \boxed{\sqrt{\frac{3g}{l}}}$

$v_{tip} = r\omega = \frac{2}{3}L\sqrt{\frac{3g}{L}} = \boxed{2\sqrt{\frac{gL}{3}}}$ +1

3) c) $\Sigma\tau = I\alpha = mg\sin\theta \cdot \frac{1}{6}L = I\frac{d^2\theta}{dt^2}$

$\theta = \theta_{max}\sin(\omega t)$

$\frac{d\theta}{dt} = \theta_{max}\omega\cos(\omega t)$

$\frac{d^2\theta}{dt^2} = -\theta_{max}\omega^2\sin(\omega t)$

$\frac{1}{6}mgL\sin\theta = -I\theta_{max}\omega^2\sin(\omega t)$

$\theta = 0 \quad 0 = -I\theta_{max}\omega^2\sin(\omega t)$?

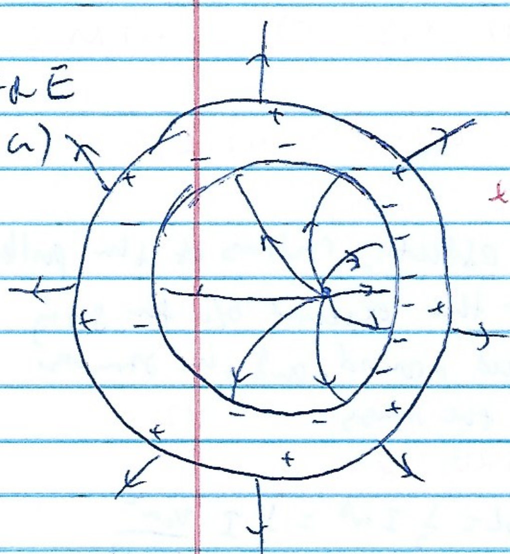
3) c) $T = 2\pi\sqrt{\frac{I}{mgd}}$ +1 $= 2\pi\sqrt{\frac{mL^2/9}{mgL/6}}$ +1

$d = \frac{L}{6}$ +1 $= \boxed{2\pi\sqrt{\frac{2L}{3g}}}$ +1

turn

FRE

1) a)



+2

b) ?

3) a) $\Phi = \int B \cdot dA$

$\oint B \cdot dl = \mu_0 I$

$B \cdot 2\pi r = \mu_0 I$

$B = \frac{\mu_0 I}{2\pi r}$

$\Phi = \int_{l}^{4l} \frac{\mu_0 I}{2\pi r} \cdot 4l\,dr \quad dA = 4l\,dr$ +1

$= \frac{\mu_0 I}{2\pi} \cdot 4l \int_{l}^{4l} \frac{dr}{r}$ +1

$= \frac{2\mu_0 I l}{\pi}\left(\ln|r|\right)_{l}^{4l}$

$= \frac{2\mu_0 I l}{\pi}\ln\left|\frac{4l}{l}\right|$ +1

$= \boxed{\frac{2\mu_0 I l}{\pi}\ln 4}$ +1

c) $\mathcal{E} = \frac{-d\Phi}{dt} = IR$

$I = \frac{\mathcal{E}}{R} = -\frac{1}{R}\frac{d\Phi}{dt}$ +1

$= -\frac{1}{R}\frac{d}{dt}\left(\frac{2\mu_0 l}{\pi}\ln 4\, I_0 e^{-kt}\right)$ +1

$= \frac{-1}{R} \cdot -k \cdot \frac{2\mu_0 l}{\pi}\ln 4\, I_0 e^{-kt}$ +1

$= \boxed{\frac{2\mu_0 k l}{\pi R} I_0 e^{-kt}\ln 4}$

+7

3) d) $U = \int_0^\infty P\,dt \qquad P = I^2 R$

$= R\int_0^\infty \left(\frac{2\mu_0 k l \ln 4}{\pi R}\right)^2 (I_0 e^{-kt})^2\,dt$

$= \frac{4\mu_0^2 k^2 l^2 (\ln 4)^2 I_0^2}{\pi^2 R} \int_0^\infty e^{-2kt}\,dt$

$= \quad " \quad \left(-\frac{1}{k} e^{-kt}\right)_0^\infty$

$= \quad " \quad \left(0 + \frac{1}{k}\right)$ ϕ

$= \boxed{\frac{4\mu_0^2 k l^2 (\ln 4)^2 I_0^2}{\pi^2 R}}$

+4 BE

1) b) V_a 4 V_b 3 V_c 2

V_d 1 V_e 3 +2

3) d) $\frac{4\mu_0^2 k^2 l^2 (\ln 4)^2 I_0^2}{\pi^2 R} \int_0^\infty e^{-2kt}\,dt$

$= \quad " \quad \left(-\frac{1}{2k}\right) e^{-2kt}\Big|_0^\infty$

$= \left(\frac{2 l \mu_0 I_0}{\pi} \ln 4\right)^2 \frac{k}{2R}$ +2

+4 RE