1998

	Mech			E/M		
	B	BB	BBR	B	BB	BBR
Mc	30	34	35	31	32	35
MCs	38.6	43.7	45	40.0	41.1	45
FR	42.5	45	45	34	42	44
Tot	78.1	88.7	90	74	83.1	89

1998 Mech MC

total Mech:

$45 \cdot \frac{30}{35} + 42 = \boxed{80.6}$ /90

MC: $\frac{30}{35}$

1) b ✓ 2) e ✓ 3) d ✓

4) $\Sigma F = 0$ when $a = 0$

$\frac{dx}{dt} = 3t^2 - 12t + 9$

$\frac{d^2x}{dt^2} = 6t - 12$

$t = 2$ (b) ✓

5) $2F3R - F3R - F2R - F3R$

$6FR - 6FR - 2FR$ (c) ✓

6) $v = R\omega$ (a) ✓

7) (a) ✓ 8) $F = \frac{GmM}{R^2}$ $F_a = \frac{GmM}{4R^2}$ (d) ✓

9) $\frac{dx}{dt} = -\frac{9}{2}x^2$ $x(t) = -\frac{3}{2}x^3$ (c) d guess

10) $T = 2\pi\sqrt{\frac{g}{L}}$ (e) a

11) e ✓ 12) $F\Delta t = \Delta p = 40$ kg m/s (a) c

13) $mv = (3m)v_f$

$v_f = \frac{1}{3}v$ (a) c

14) $\frac{mv^2}{r} = F_c = F_s = kx = (100 N/m)(0.03 m)$

$= 3N$ (b) ✓

15) (a) ✓

16) $3U_0 - U_0 = \frac{1}{2}mv^2$

$4U_0 = mv^2$ (c) ✓

$v_f = \sqrt{\frac{4U_0}{m}}$

17) $U(r) = br^{-\frac{3}{2}} + c$

$W = \int F \cdot dr$ $\frac{dW}{dr} = F$

$F = -\frac{3}{2}br^{-\frac{5}{2}}$ (a) ✓

18) (b) ✓

19) 11,000 N $\Sigma F = ma$

$a = 1 m/s^2$

10000 N

$\cancel{v_f} = v_0 + at$ $a = -\frac{v_0}{t}$

$\cancel{v_f^2} = v_0^2 + 2a\Delta x$

$v_0^2 = -2a\Delta x$ $v_0 = \sqrt{2(1)(8)}$

$= \sqrt{16} = 4$ (a) ✓

20) $F = \frac{GMm}{r^2} = \frac{Mv^2}{r}$

$\frac{GM}{D} = \frac{2v^2}{1}$

$v^2 = \frac{GM}{2D}$ (b) ✓

21) $F\cos\theta - f = ma$ (d) ✓

22) $F\sin\theta + N - mg = 0$

$N = mg - F\sin\theta$

$f = \mu N$

$\mu = \frac{f}{N} = \frac{f}{mg - F\sin\theta}$ (e) ✓

23) X N/A

24) (a) ✓ 25) (b) ✓

26) $\bar{v} = \frac{\Delta x}{t}$

$\Delta y = \cancel{v_0 t} + \frac{1}{2}gt^2$

$t = \sqrt{\frac{2\Delta y}{g}}$ $v = \frac{3m}{\sqrt{\frac{2(10m)}{10}}} = \frac{3}{\sqrt{2}}$ (c) ✓

27) $W = \int_0^2 F \cdot dx = \int_0^2 40x - 6x^2 dx$

$= 20x^2 - 2x^3 \Big|_0^2 = 80 - 16 J = 64 J$ (d) ✓

28) (c) ✓ 29) $\frac{dx}{dt} = -A\omega \sin\omega t$

$\frac{dy}{dt} = A\omega\cos\omega t$

$\frac{d^2y}{dx^2} = \frac{\frac{d}{dt}\left(\frac{dy}{dx}\right)}{\frac{dx}{dt}}$

$\frac{dy}{dx} = -\cot\omega t$

$= \frac{\omega}{\sin^2\omega t(-A\omega\sin\omega t)}$

$A\sin^3\omega t$

$\frac{d^2x}{dt^2} = -A\omega^2 \cos\omega t\ \hat{i}$

$\frac{d^2y}{dt^2} = -A\omega^2 \sin\omega t\ \hat{j}$

Assuming $t=0$?

$a = -A\omega^2(\cos\omega t\ \hat{i} + \sin\omega t\ \hat{j})$

$= -1.5(4)(1\hat{i})$

$= 6\ \frac{m}{s^2}$ (e) ✓

30) $\Sigma\tau = I\alpha = 0$

$m_1 g a = m_2 g b$ (b) ✓

31) (e) 32) $\Sigma\tau = I\alpha$ $\omega_f = \omega_0 + \alpha t$

$\alpha = \frac{\omega_f}{T}$

$\tau = \frac{I\omega_f}{T}$ (e) ✓

33) $W = \int \tau\, d\theta$ Skipped 32?

$KE_f = \frac{1}{2} I\omega_f^2$

$\frac{W}{t} = \int \tau \cdot \frac{d\theta}{t}$

$\frac{W}{T} = \frac{I\omega_f^2}{2T}$ (b) ✓

34) $\frac{dv}{dt} = g - bv$

$\frac{dv}{g-bv} = dt$

$u = g - bv$ $\frac{du}{dv} = -b$

$t = -\frac{1}{b}\ln|g-bv|$

$dv = \frac{du}{-b}$

$-bt = \ln|g-bv|$

$g - bv = e^{-bt}$

$bv = g - e^{-bt}$

$v = \frac{1}{b}(g - e^{-bt})$ (a) ✓

35) $\frac{1}{2}mv_m^2 = \frac{1}{2}kA^2$

$k = \frac{mv_m^2}{A^2}$ (d) ✓

$\frac{42.5}{45} \rightarrow \frac{42}{45}$ (trunc.)

1998 Mech FR

1) a) (i) ~~$\bar{v} = \frac{x}{t} = \frac{0.5m}{0.5s} = 1 \frac{m}{s}$~~

~~(ii) $\bar{v} = \frac{x}{t} = \frac{0.44m}{0.5s} = 0.88 \frac{m}{s}$~~

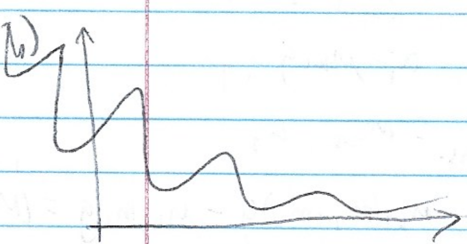
~~(iii) $\bar{v} = \frac{x}{t} =$~~

(i) $\bar{v} = \frac{\Delta x}{t} = \frac{0.2m}{0.2s} = \boxed{1 \frac{m}{s}}$ ✓ +1

(ii) $\bar{v} = \frac{\Delta x}{t} = \frac{0.12m}{0.2s} = \boxed{0.6 \frac{m}{s}}$ ✓ +1

(iii) $\bar{v} = \frac{\Delta x}{t} = \frac{0.04m}{0.2s} = \boxed{0.2 \frac{m}{s}}$ +1 ✓

b)



c) (i) $m_a v_{a_0} + \cancel{m_b v_{b_0}} = \cancel{m_a v_{a_f}} + m_b v_{b_f}$ +1

$(0.40kg)(1 \frac{m}{s}) =$ $0.40kg\, v_{af} + 0.60kg(v_{bf})$

+1

$= 0.40kg(0.2 \frac{m}{s}) + 0.60kg(v_{bf})$

$v_b = \frac{0.40kg(1 \frac{m}{s} - 0.2 \frac{m}{s})}{0.60kg} = \boxed{1.2 \frac{m}{s}}$ +1

d) (i) Yes, KE is conserved. +1 +1

(ii) the kinetic energy is stored in spring potential energy. +1

2) a) (i) $m v_0 = 3m(v_f)$ +1

$v_f = \frac{v_0}{3}$ +1

$KE = \frac{1}{2}(3m) v_f^2$

$= \frac{1}{2}(3m)\left(\frac{v_0}{3}\right)^2$

$= \boxed{\frac{1}{6} m v_0^2}$ +1

(ii) $KE_0 = \frac{1}{2} m v_0^2$

$\Delta KE = KE_f - KE_0 = \boxed{-\frac{1}{3} m v_0^2}$ +1 +1

b) m o——ℓ——o 2m

(i) x_{cm} $\quad x_{cm} = \frac{m_1 x_1 + m_2 x_2}{m_{total}}$ +1

$= \frac{(m)(0m) + 2m(\ell)}{3m}$ +1

$= \boxed{\frac{2}{3}\ell}$ from the left end

(ii) $\uparrow v_{cm}$ +1

m o————o 2m

(iii) $m v_0 = 3m(v_f)$

$v_f = \boxed{\frac{v_0}{3}}$ +1

~~$v_{cm_0} = v_{cm_f}$~~

(iv) $L_0 = L_f$ $\quad I = m\left(\frac{2\ell}{3}\right)^2 + 2m\left(\frac{\ell}{3}\right)^2$

$= \frac{4}{9} m\ell^2 + \frac{2}{9} m\ell^2$

$= \frac{2}{3} m\ell^2$ +1

+1

$r p = I\omega_f$

$\omega_f = \frac{\frac{1}{3}\ell \cdot m v_0}{\frac{2}{3} m\ell^2} = \boxed{\frac{v_0}{2\ell}}$ +1

(v) $KE_0 = \frac{1}{2}mv_0^2$

$$KE_f = \underbrace{\frac{1}{6}mv_0^2}_{\text{linear (para)}} + \underbrace{\frac{1}{2}\left(\frac{2}{3}m\ell^2\right)\left(\frac{v_0}{2\ell}\right)^2}_{\text{rotational}}$$

~~Rotational~~ +1

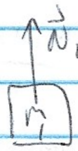
$$= \frac{1}{6}mv_0^2 + \frac{1}{3}m\ell^2 \cdot \frac{v_0^2}{4\ell^2}$$

$$= \frac{3}{12}mv_0^2 = \boxed{\frac{1}{4}mv_0^2}$$ +1

$$\Delta KE = KE_f - KE_0 = \boxed{-\frac{1}{2}mv_0^2}$$ ✗

brah!!

3) a) (i)



+1

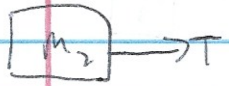
$N_1 = m_1 g$

(ii)

✗

$F_f = \mu_{s1} N = \mu_{s1} m g$

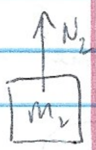
(iii)



+1

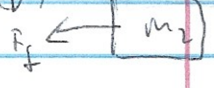
$\Sigma F = 0 \quad T = Mg$

(iv)



$N_2 = (m_1 + m_2) g$ +1

(v)



$F_f = \mu_{s2}(m_1 + m_2) g$ +1/2 ✗

b) $Mg - \mu_{s2}(m_1 + m_2) g = 0$ +1 +1

$M = \mu_{s2}(m_1 + m_2)$ +1

c) $\Sigma F_{\text{system total}} = ma$ +1

$Mg - \mu_{k2}(m_1 + m_2) g = (M + m_1 + m_2) a$ +1

$$\boxed{a = \frac{Mg - \mu_{k2}(m_1 + m_2) g}{M + m_1 + m_2}}$$ +1

d) $\Sigma F_1 = m_1 a_1$

(i) $F_f = m_1 a_1$

$\mu_{k1} \cancel{m_1} g = \cancel{m_1} a_1$ +1

$a_1 = \mu_{k1} g$ +1

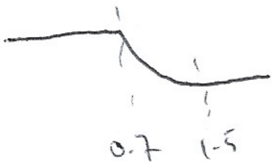
(ii) $\Sigma F_{sys.} = m_{\text{total}} a_2$

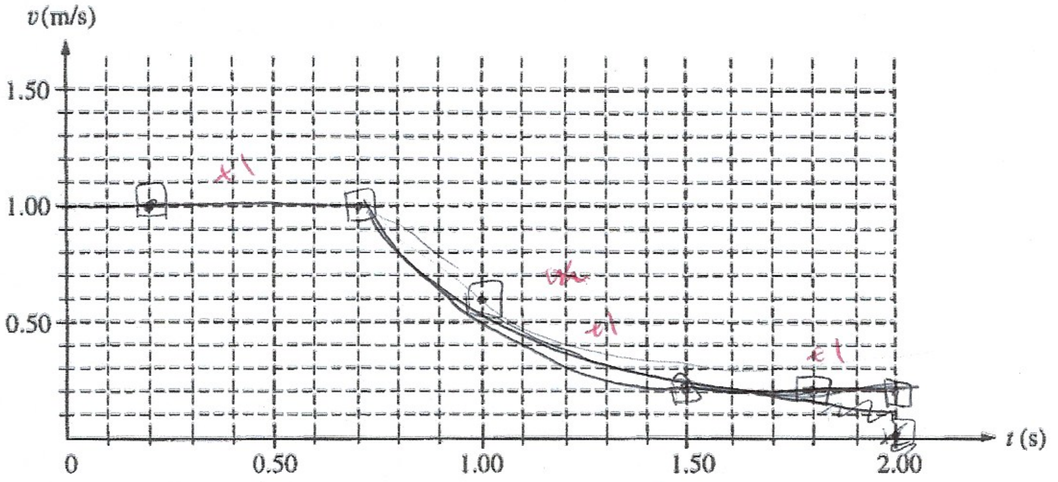
$Mg - \mu_{k2}(m_1 + m_2) g - \mu_{k1} m_1 g = (M + m_2) a_2$ +1

$$\boxed{a_2 = \frac{Mg - \mu_{k2}(m_1 + m_2) g - \mu_{k1} m_1 g}{M + m_2}}$$ +1

−2.5

1) (b) On the axes below, sketch a graph, consistent with the data above, of the speed of glider A as a function of time t for the 2.00 s interval.

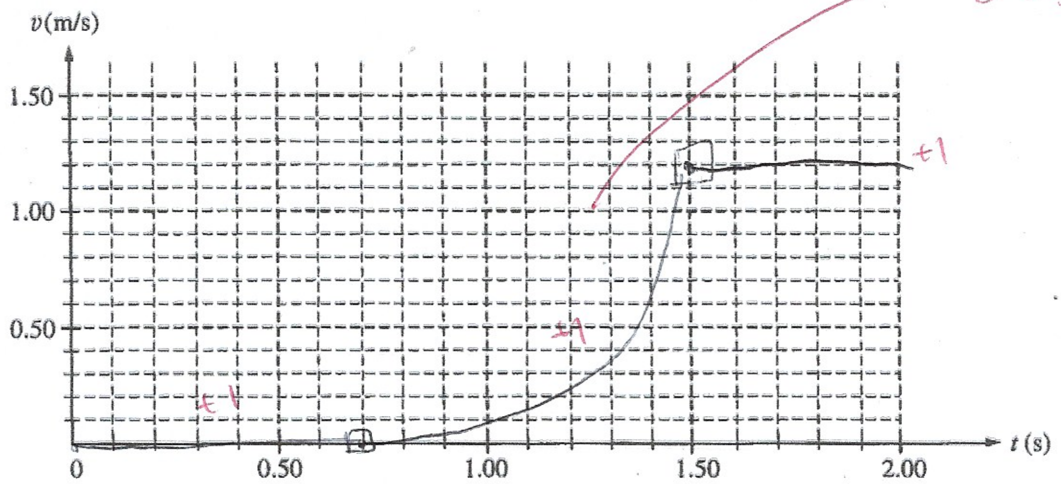




(c) i. Use the data to calculate the speed of glider B immediately after it separates from the spring.

ii. On the axes below, sketch a graph of the speed of glider B as a function of time t.

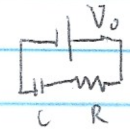
Monotonic, +5 slope



GO ON TO THE NEXT PAGE

1998 EM MC $\frac{31}{35}$ MC

EM total $\frac{45}{35} \cdot \frac{31}{\cancel{45}} \cdot \cancel{\frac{45}{45}} + \frac{34}{\cancel{45}} = \boxed{\frac{74}{90}}$

36) 

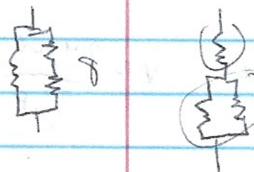
V_0 C R

$I = \frac{dQ}{dt}$

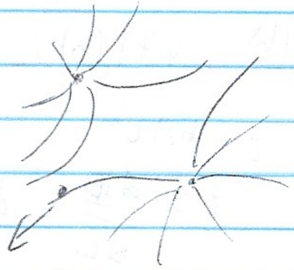
$P = I^2 R$ $V = \frac{Q}{C}$ (b) ✓

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

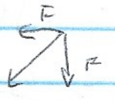
$R = \frac{V^2}{P} = \frac{144 V^2}{24 W} = 6\ \Omega$



4 8 4 2 (e) ✓

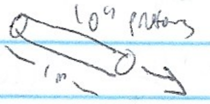
38) (c) ✓ 39) 

(e) ✓

40) $F = \frac{k Q q}{S^2}$ 

F F $F\sqrt{2}$ (d) ✓

41) (c) ✓ 42) $P = I^2 R$ (d) ✓

43) $I = \frac{dQ}{dt}$ 

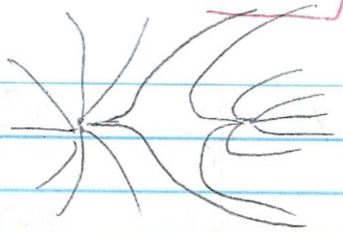
10^9 protons 1 m

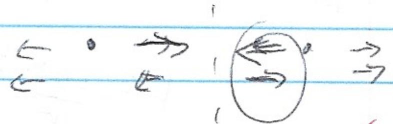
$= \frac{Q}{t}$ $\frac{Q}{d} \cdot d$

$= \frac{Q}{d} \cdot \frac{d}{t} = (10^9 \text{ protons}/m)(1.6 \times 10^{-19} C) \cdot v$

$= 1.6 \times 10^{-3} A$

$v = 1e7\ m/s$ (d) ✓

44) (a) ✓ 45) 



(c) ✓ II, III

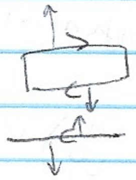
46) $V = \frac{kQ}{r}$ (e) ✓

47) (c) d

48) $W = \Delta U = q \Delta V$

$\Delta V = \frac{U}{q} = \frac{5J}{2mC}$

$= 2.5e3$ (c) ✓

49) 

(a) ✓

50) (d) ✓ 51) $\cancel{Q}\ \cancel{\frac{1}{2} C V^2 = \frac{1}{2} Q V}$

$\cancel{C = \frac{Q}{V}}$ $V = \frac{Q}{C} = \frac{Q d}{\varepsilon_0 A}$

$U = q V = \frac{Q e d}{\varepsilon_0 A}$ (a) ✓

52) (d) c 53) (c) ✓ 54) (e) ✓

55) $\frac{m v^2}{R} = \frac{k e^2}{R^2}$

$m v^2 = \frac{1}{4 \pi \varepsilon_0} \cdot \frac{e^2}{R}$

$K = \frac{1}{2} m v^2$ (b) ✓

56) CCW $\mathcal{E} = -\frac{d\Phi}{dt}$

$= -L^2 \frac{dB}{dt} = -L^2(-b) = bL^2$ (e) ✓ -2

$I = \frac{\mathcal{E}}{R} = \frac{bL^2}{R}$

57) $qvB = \frac{mv^2}{r}$ $\frac{2\pi r}{T} = v$

$v = \frac{qBr}{m}$ ~~[illegible]~~ $2\pi r f = v$

$f = \frac{v}{2\pi r}$

$f = \frac{qB\cancel{r}}{m} \frac{1}{2\pi \cancel{r}}$

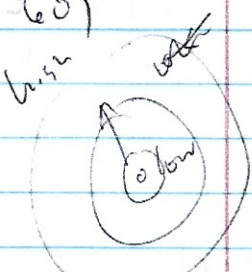
(a) ✓

58) constant field → constant force → const. acceleration

(a) ✓

59) $E = \frac{-dV}{dr} = -2kr_0$ (c) ✓

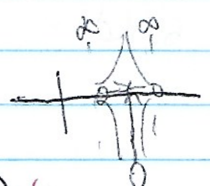
60) high ~~[illegible]~~ electron - goes low to high potential



F away

E toward (b) ✓

61)



(a) ✓

62) (d) ✓ 63) $W = qV$

$V_{[illegible]} = \frac{kQ}{r_{A}}$ & $W = \frac{kQq}{r}$

~~[illegible]~~ $\oint E_{[illegible]} \cdot dA = \frac{Q_{enc}}{\varepsilon_0}$

~~$E \cdot 4\pi r^2 = \frac{Q}{\varepsilon_0}$~~ $E_{inside} = 0$

$V = \int E \, dr = 0$

(b) c

-1

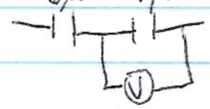
64) $\left((6\mu F^{-1}) + (3\mu F)^{-1}\right)^{-1}$

$= 2\mu F$ (b) ✓

65) $V = \frac{Q}{C}$ $Q_{total} = C_{eq}V = (2\mu F)(12V)$

$= 24\mu C$

6μF 3μF



Q equal V splits

$24\mu C$ $V = \frac{24\mu C}{3\mu F} = 8V$

(d) ✓

66) (b) ✓ 67) (b) c

68) $\mathcal{E} = bAt^{\frac{1}{2}}$

$\mathcal{E} = \frac{d\Phi}{dt} = dAt^{\frac{1}{2}}$

$\cancel{A}\, dB = d\cancel{A}t^{\frac{1}{2}}dt$

$B = d\int t^{\frac{1}{2}}dt$

$= \frac{2d}{3}t^{3/2}$ (e) ✓

69) $E = \frac{\Delta V}{\Delta x}$ (b) ✓

70) $\mathcal{E} = \frac{k\varepsilon_0 A}{d}$ (a) ✓

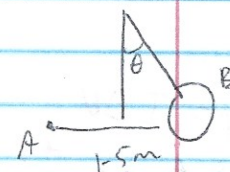
-1

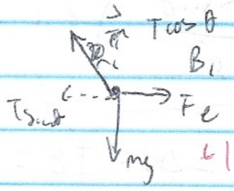
1998 EM FR

34/45

1)

a)





+1

$T\cos\theta = mg$

$T = \frac{mg}{\cos\theta}$ +1 $T\sin\theta = F_e = \frac{kQ_BQ_A}{r^2}$

$mg\tan\theta = \frac{kQ_BQ_A}{r^2}$

$Q_B = \frac{mg\tan\theta r^2}{kQ_A}$ +1

$= \frac{(0.025\,kg)(9.8\,m/s^2)\tan(20)(1.5m)^2}{(9.0\times10^9\,\frac{Nm^2}{C^2})(120\times10^{-6}\,C)}$

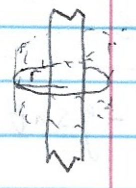
$= \boxed{18.6\,\mu C} = \boxed{1.86\times10^{-7}\,C}$ +1

b) the equilibrium angle will remain the same since the mass, radius, or charge didn't change; the conducting sphere will still have the charge distributed evenly through the outer surface. The force still acts through the center of the sphere.

-2

c) $\int E\cdot dA = \frac{Q_{enc}}{\varepsilon_0}$ $\lambda = \frac{Q}{l}$ +1

~~$\oint E\cdot 2\pi r\,dl = \frac{\lambda}{l\varepsilon_0}$~~



$A = 2\pi r l$

$\oint E\cdot 2\pi r\,\cancel{dl} = \frac{\lambda\,\cancel{dl}}{\varepsilon_0}$ +1

$E\cdot 2\pi r = \frac{\lambda}{\varepsilon_0}$ -2

$E = \frac{\lambda}{2\pi\varepsilon_0 r} = \frac{0.10\,\mu C/m}{2\pi(8.85\times10^{-12}\,\frac{C^2}{Nm^2})r}$

$= \frac{1.80\times10^3}{r}\,N/C$ +1

d) $F = qE = (120\,\mu C)\left(\frac{1.8\times10^3}{1.5\,m}\,N/C\right)$ +1

$= \boxed{0.144\,N}$ +1

e) $\Delta V = -\int E\cdot dr$

$= +\int_{0.3}^{1.5}(1.80\times10^3)\frac{dr}{r}$ +1 +1

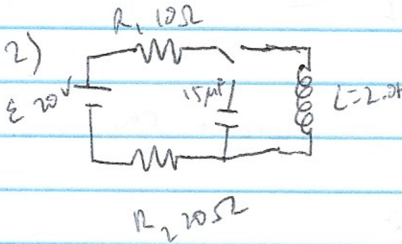
$= +1.80\times10^3\left(\ln|1.5| - \ln|0.3|\right)$

$= +2.90\times10^3\,V$

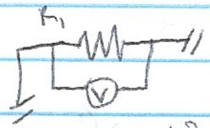
$W = qV = (120\,\mu C)(2.90\times10^3\,V)$ +1

$= \boxed{0.348\,J}$ +1

2)



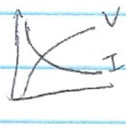
a)



+2

b) $V = IR_1$ $I = \frac{dQ}{dt}$

$V = \frac{Q}{C}$ $Q = CV$



$R_{eq} = 30\,\Omega$

$C = 15\,\mu F$ $\tau = RC = 4.5\times10^{-4}$

$\boxed{V=0}$? -3

0

$I = C\frac{dV}{dt} = \frac{\varepsilon_0}{R_{eq}}$

$\frac{dV}{dt} = \frac{\varepsilon}{RC}$ $V(t) = \int\frac{\varepsilon}{RC}\,dt$

-3

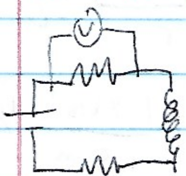
c) (i) $I=0$ $\boxed{V=0}$ +2

(ii) $Q = CV = (15\,\mu F)(20\,V)$

$= \boxed{3\times10^{-4}\,C}$

$300\,\mu C = 3\times10^{-4}\,C$ +1

d) $t = T$



$V = IR = \frac{(20V)}{30\Omega}(10\Omega) = \boxed{6.67\,V}$

-2

$I = \frac{\varepsilon}{R_{eq}}$

e) (i) $I_f = \frac{\varepsilon}{R_{eq}} = \frac{20V}{30V} = \boxed{0.67\,A}$ +2

(ii) $U_L = \frac{1}{2}LI^2 = \frac{1}{2}(20H)(0.67A)^2$

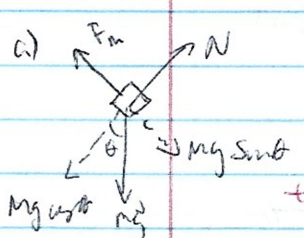
$= \boxed{0.45\,J}$ +1

f) $\varepsilon_L = -L\frac{dI}{dt} = \varepsilon$

-2

$\frac{dI}{dt} = -\varepsilon L$

3) a)



Current CW

+1

+1

$F_m = IlB = mg\sin\theta$ +1

$\boxed{I = \frac{mg\sin\theta}{Bl}}$ +1

$\varepsilon = Blv$ +1 $I = \frac{\varepsilon}{R}$ +1

skipped the derivation $\frac{mg\sin\theta}{Bl} = \frac{Blv}{R}$

-1

-5

$\boxed{v = \frac{mgR\sin\theta}{B^2 l^2}}$ +1

$P = I^2R = I\Delta V$ +1

c) $P = I\Delta V = I\varepsilon = \frac{mg\sin\theta}{Bl}\cdot Blv$

$= mgv\sin\theta = mg\sin\theta\cdot\frac{mgR\sin\theta}{B^2l^2}$

$= \boxed{\frac{m^2g^2\sin^2\theta\, R}{B^2l^2}}$ +1

d) $\Sigma F = mg\sin\theta - IlB = m\frac{dv}{dt}$

$I = \frac{dQ}{dt} = \frac{V}{R} = \frac{Blv}{R}$ +1

$mg\sin\theta - \frac{B^2l^2v}{R} = m\frac{dv}{dt}$

$g\sin\theta - \frac{B^2l^2v}{mR} = \frac{dv}{dt}$

$dt = \frac{dv}{g\sin\theta - \frac{B^2l^2}{mR}v}$ +1

$u = g\sin\theta - \frac{B^2l^2}{mR}v$

$\frac{du}{dv} = -\frac{B^2l^2}{mR}$

$dv = -\frac{mR}{B^2l^2}du$

$t = -\frac{mR}{B^2l^2}\ln\left|g\sin\theta - \frac{B^2l^2}{mR}v(t)\right|$

$-\frac{B^2l^2t}{mR} = \ln\left|\quad\right|$

$g\sin\theta - \frac{B^2l^2}{mR}v(t) = e^{-\frac{B^2l^2t}{mR}}$

$\boxed{v(t) = -\frac{mR}{B^2l^2}\left(e^{-\frac{B^2l^2t}{mR}} - g\sin\theta\right)}$

-1

(e) the final speed will be less. +1
Because power is being dissipated through both resistors now, because of Conservation of Energy, the bar must move at a slower speed since more energy is being dissipated through the resistors.

this is reasonable, right? +1

1998 BR

Mech MC

10) $T = 2\pi\sqrt{\frac{l}{g}}$ $T_f = 2T$

$\frac{1}{\sqrt{g_f}} = 2$

$\sqrt{g_f} = \frac{1}{2}$ $g_f = \frac{1}{4}$ (a) ✓

9) ?

11) ~~$\frac{Mv^2}{r}$ $\omega = v$~~ I ✓ II ✓ III ✓ (e)

12) $J = \Delta p = F\Delta t = 10N(2s) - 10N(2s)$

$= 0$ (c) ✓

13) $mv + mv = (3m)v_f$

$v_f = \frac{2}{3}v$ (c) ✓

22) $\Sigma\tau = I\alpha$

$\omega_f = \omega_i + \alpha T$

$\alpha = \frac{\omega_f}{T}$

$\tau = \frac{I\omega_f}{T}$ (e) ✓

9) d

E/M MC

47) (e)? 52) c ✓

63) $W = \Delta U$

~~$\frac{kQq}{(r+R)}$~~ $\frac{kQq}{r} - \frac{kQq}{R}$

$\frac{kQq}{r}$ (b)

67) (b) 47) d 63) e 67) a

Mech FR

2) i) $\Delta KE = KE_f - KE_0 = \boxed{-\frac{1}{4}mv_0^2}$ +1

3) (ii) $\boxed{m_1}$ $F = 0$ ✓ +1

(v) $\boxed{m_2}$ F_f $F_f = Mg$ ✓ +1/2

E/M FR

1) b) The angle will be less b/c the conducting sphere allows the charges to gather on the far end of the sphere away from A, thus increasing the distance & decreasing the electrostatic force. +1 +1

2) b) $\Delta V_{ab} = I R_{eq}$

$I = \frac{\varepsilon}{R_{eq}} = \frac{20\ V}{(10\Omega + 20\Omega)} = 0.667\ A$ +1 +1

$V = IR = (0.667A)(10\Omega) = \boxed{6.67\ V}$ +1

d) $V_f = 0$; $I_0 = 0$ +2

f) ?

3) a) $\mathcal{E} = \frac{-d\Phi}{dt} = \frac{B \cdot dA}{dt} = Bl \cdot \frac{dr}{dt}$

$= Blv$ +1

c) ∩

2) f) $\mathcal{E} - I(R_1 + R_2) - L\frac{dI}{dt} = 0$ +1

3) d) $v(t) = \frac{mRg\sin\theta}{B^2 l^2}\left(1 - e^{\frac{-B^2 l^2 t}{mR}}\right)$ +1