Energy Practice Test

#1 Decreasing speed = Decreasing K

$W = \Delta K$ so if K is decreasing, ΔK is negative

$\therefore$ W is negative

E

#2 $1 \text{ Joule} = \cancel{1 N/s} = 1 N \cdot m = 1 \ \underline{kg\,m/s^2} \cdot m = kg\,m^2/s^2$

E

#3 $K = \frac{1}{2} m v^2$ $\quad V_{AVE} = \frac{\Delta x}{\Delta t} = \frac{42{,}200 m}{3.5 hr} \Big/ \frac{1 hr}{3600 s} = 3.35 m/s$

$K = \frac{1}{2}(75 kg)(3.35 m/s)^2 = 421 J$

E

#4 $W = \Delta K$

from 0→30 $\Delta K = \frac{1}{2} m (V_2^2 - V_1^2) = \frac{1}{2} m (30^2 - 0^2) = 450 m$

from 30→60 $\Delta K = \frac{1}{2} m (V_2^2 - V_1^2) = \frac{1}{2} m (60^2 - 30^2) = 1350 m$

C

#5 $K \sim V^2$ if V increases by 20% V_{new} 1.2V

$K_{NEW} \sim V_{new}^2$

so $K_{NEW} \sim 1.44 V^2$

C

(#6) $W = \Delta K$ $\qquad F\Delta x = \frac{1}{2}m(V_2^2 - V_1^2)$

$$F = \frac{m(V_2^2 - V_1^2)}{2\Delta x} = \frac{(.012kg)(640 m/s^2 - 0^2)}{2(.052m)}$$

$F = 47{,}260\ N$

$\boxed{A}$

(#7) $K \sim V^2$ if V is doubled $K = V^2$

or $4x$

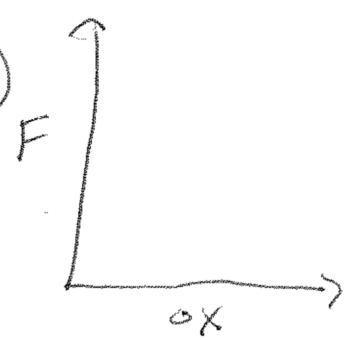
$\boxed{D}$

(#8) $W = F \times D$ if constant velocity,

$A = 0 \therefore F_{NET} = 0 \therefore W = 0$ for resultant (net) Force

$\boxed{E}$

(#9)



Area under curve = $F\Delta x$
which = Work

$\boxed{B}$

(#10) $W_1 = F_1 \Delta x_1 = 0\ J$

$W_2 = F_2 \Delta x_2 = (3N)(5m) = 15J$

$W_3 = F_3 \Delta x_3 = (6N)(5m) = 30J$

$W_4 = F_4 \Delta x_4 = (3N)(5m) = 15J$ — $F_4 = 3N$ since it uniformly decreases $F_{4Avg} = \frac{6N + 0N}{2}$

$60J$

$\boxed{D}$

(#11) $U_{TOP} = K_{BOT}$ $mgh_{TOP} = \frac{1}{2} m v_{BOT}^2$

$V_{BOT} = \sqrt{2gh} = \sqrt{2(10m/s^2)(1m)} = 4.47 m/s$

$\boxed{B}$

(#12) U is independant of time

$\boxed{A}$

(#13) $\boxed{E}$ - Potential Energy is a relative function (relative to any arbitrary pt.)

(#14) $K = \frac{1}{2} m v^2$ Alway positive (M alway +, V^2 always +)

$U = mgh$ Can be positive or negative (h can be + or −)

$\boxed{D}$

#15 $\Delta U = mg\Delta h = (75kg)(10 m/s^2)(16m) = 12{,}000 J$

$\boxed{A}$

#16 $U_{SPRING} = \frac{1}{2} k \Delta x^2 = \frac{1}{2}(300 N/m)(.09m)^2 = 1.22 J$

must be in m

$\boxed{E}$

#17 Law of Conservation of Energy

$\boxed{D}$

#18 $U = mgh$ slope $= m \cdot g$ if $m = 1 kg$

$y = mx + \cancel{b}$ 0 slope $= g$

slope $= \frac{\Delta y}{\Delta x} = \frac{60-0}{20-0} = 3$

$\boxed{D}$

#19 $\boxed{C}$ - Definition of Mechanical Energy

#20 If $K_0 = 450 J$ & $K_f = 250 J$ by conservation of Energy $\to U = 200 J$ $h = \frac{U}{mg} = \frac{200 J}{M \cdot g}$

$\boxed{D}$

(#21) At top of Loop $\vec{F}_g + F_{Rail} = \frac{mv^2}{R}$ $F_{rail} = -mg + \frac{mv^2}{R}$

By conservation of Energy

$U_{TOP} = (U+K)_{loop}$ $\cancel{m}gh_{top} = \cancel{m}gh_{rail} + \frac{1}{2}\cancel{m}v_{rail}^2$

$v = \sqrt{2(gh_{top} - gh_{rail})} = \sqrt{2(10\,m/s^2)(23-15)}$

$= \sqrt{160} = 12.6\,m/s$

$F_{rail} = (1500\,kg)\left[-10\,m/s^2 + \frac{(12.6\,m/s)^2}{7.5\,m}\right] = \cancel{47{,}000}\,N$

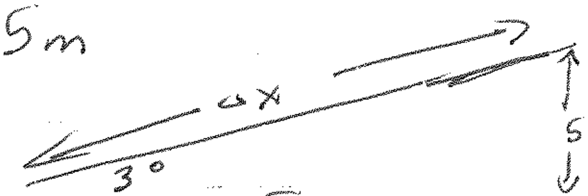
$= 16{,}750\,J$

$\boxed{C}$

(#22) $\Delta K = \Delta U$

$\frac{1}{2}\cancel{m}v^2 = \cancel{m}gh$

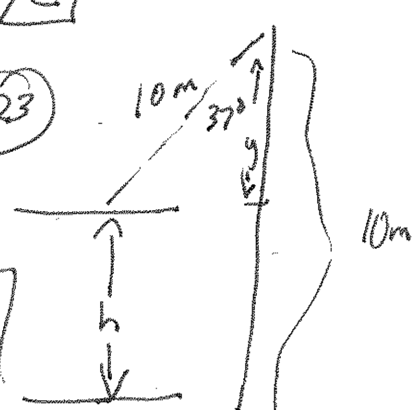
$h = \frac{v^2}{2g} = 5\,m$



$\sin 3° = \frac{5}{\Delta x}$ $\Delta x = \frac{5}{\sin 3°} = 95.5\,m$

$\boxed{C}$

(#23)



$\boxed{D}$

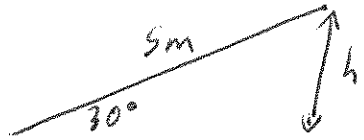
$U_{TOP} = K_{B.T}$ $v = \sqrt{2gh}$

$\cos 37° = \frac{y}{10}$ $y = 10\cos 37° = 8\,m$

$h = 10 - y = 2\,m$

$v = \sqrt{2(10\,m/s^2)(2\,m)} = 6.3\,m/s$

#24 $\Delta U = mg\Delta h = (5kg)(10 m/s^2)(2.5m) = 125J$



$\sin 30° = \frac{h}{5}$ $\quad h = 5 \sin 30 = 2.5m$

$\boxed{C}$

#25 $\boxed{E}$ If only ~~a~~ conservative forces the total work done = 0 for any closed path (conservation of Energy)

#26 $W_f = F_f \cdot \Delta x \qquad F_f = \mu \cdot F_N = \mu \cdot mg\cos\theta$

$W_f = \mu mg\cos\theta\,\Delta x = (.2)(4kg)(10 m/s^2)(\cos 60°)(5m)$

$= 20J$

$\boxed{B}$

#27 Energy gained by B must equal energy lost by A.

B. $K_\uparrow = 110J \quad U_\uparrow = 98 = +208J$

A $K_\uparrow = 330J \quad U_\downarrow = 588J = -258J$

$\therefore$ 50J lost to friction

$\boxed{B}$

#28 $P = W/t$ $\quad W_{small} = P \cdot t = (1W)(2h) = 2W \cdot h$

$W_{large} = P \cdot t \quad t = \frac{W_{large}}{P_{large}} = \frac{2(2W \cdot h)}{2W}$

$= 2 \cdot hr$

$\boxed{C}$

#29 $P = W/t = \frac{m \cdot g \cdot h}{t} + \frac{\frac{1}{2} m V_{AVE}^2}{t}$ (work is changing both U & K)

$= \frac{(3.45kg)(10 m/s^2)(3m) + \frac{1}{2} m (4.5 m/s)^2}{(36m / 4.5 m/s)} \longleftarrow t = \frac{D}{V_{AVE}}$

$= 17.3 W$

$\boxed{A}$

#30 $P = W/t \quad P = \frac{3W}{5t} = \frac{3}{5}\boxed{W/t} = \frac{3}{5}P$

$\boxed{E}$

#31 $P = \frac{dW}{dt}$ for variable power

$W = \int P \, dt = \int_0^2 (2 + 2t + 3t^2) dt$

$= 2t + t^2 + t^3 \Big|_0^2 = 2(2) + (2)^2 + (2)^3 - 0$

$\boxed{D}$ $\quad = 16 J$

#32 Energy Expended = Work = Area under curve

$$\text{Area} = (20)(30-10) + \tfrac{1}{2}(20)(30-10)$$
$$= 400 + 200 = 600\ J$$

$\boxed{D}$

#33 $P = F \times V$ — Definition / Equation

$\boxed{A}$

#34 $W = mgh = mg(-h) = -W$

$\boxed{C}$

#35 Normal Force & Displacement are perpendicular

$\boxed{A}$

#36 $\boxed{C}$ $K = 0$ at start, increases to a maximum value.

#37 $P = FV$ ← Not Distance dependant →

If $P = W/t = \frac{mgh}{t} = mg\left(\frac{h}{t}\right) = mg(V)$

$\therefore$ 3P

$\boxed{C}$

#38 $W = 7000\,t^2 + 40{,}000\,t + 100{,}000$

$P = \frac{dW}{dt} = 14{,}000\,t + 40{,}000$

$P = 14{,}000(2) + 40{,}000$

$= 68{,}000\ W$

$\boxed{B}$