48 T2 SU19 Name _____ Usual seat number _____

No equation sheet. Must show all your work, using standard symbols, using a scientific calculator, to determine your one final answer that you put in a box with appropriate units. No cell phones or smart phones allowed. If you leave the test you cannot return and continue. You must sit in your assigned seat.

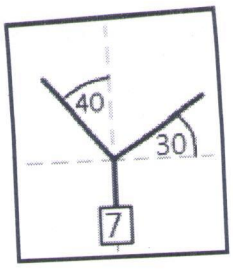
(73%) F1) A car is cruising at a constant speed of 30 mph as it goes around a large circular track. Does it accelerate?

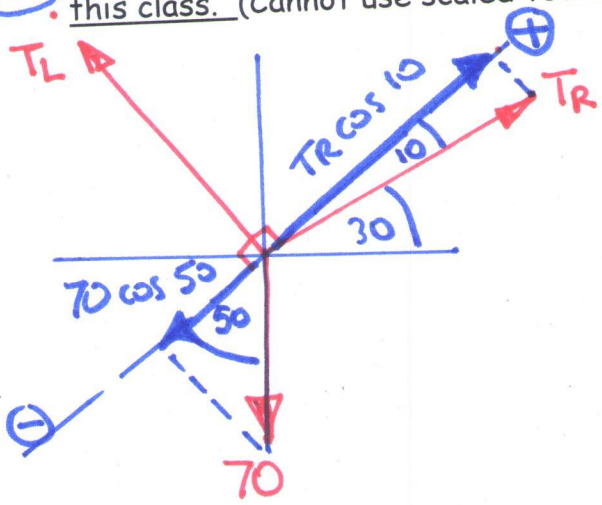
A) Yes in the direction of travel.

B) Yes in the direction in towards the middle of the circle.

C) No it is not accelerating because it has constant speed.

(58%) F2) A traffic light hangs from two wires as shown. Find the tension force in the RIGHT hand wire <u>by using one of the trigonometric methods shown in this class.</u> (Cannot use scaled vector diagram) (1pt)





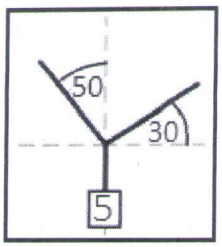
$\Sigma F_{\text{BLUE LINE}} = 0$

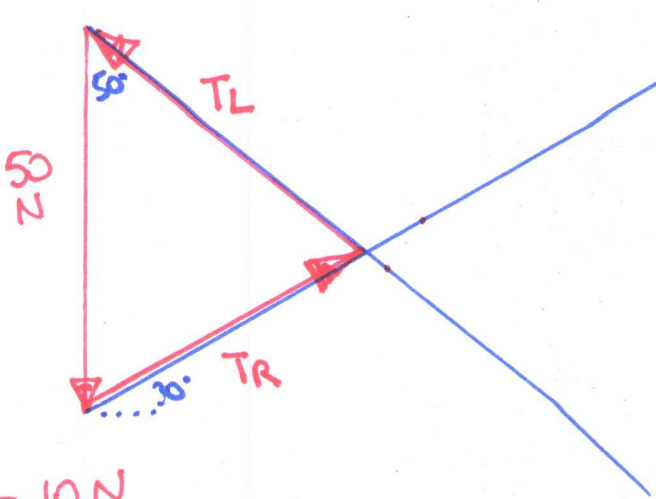
$(+T_R \cos 10) + (-70 \cos 50) = 0$

$T_R = \dfrac{70 \cos 50}{\cos 10}$

$T_R = \boxed{45.69\ \text{N}}$

(49%) F3) A traffic light hangs from two wires as shown. Find the tension force in the LEFT hand wire <u>by drawing a scaled vector diagram.</u> (Cannot use trig method) (1pt)





$T_L = (4.7)(10) = \boxed{47\ \text{N}}$

97%

F4) A bus pushes a car, causing it to accelerate along a straight and level road. Which statement below is correct for this period of motion? Circle the correct statement. (1pt)

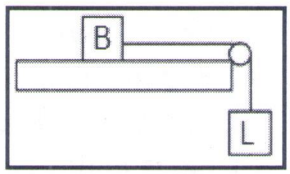
(A) The force of the bus on the car is less than the force of the car on the bus.

(B) The force of the bus on the car is equal to the force of the car on the bus.

(C) The force of the bus on the car is more than the force of the car on the bus.

58%

G1) A 6kg block rests on a rough table. There is a 0.4 coefficient of kinetic friction between the block and the table. An 8kg load is connected to the block by a string that passes over a massless and frictionless pulley. What is the tension in the string once the system is free to move? (1pt)



$F_F = \mu F_N$

$F_F = (0.4)(60)$

$F_F = 24N$

$\Sigma F_8 = M_8 a_8$

$(+80) + (-T) = 8a$

$T = 80 - 8a$

$\Sigma F_{SYST} = M_{SYST} a_{SYST}$

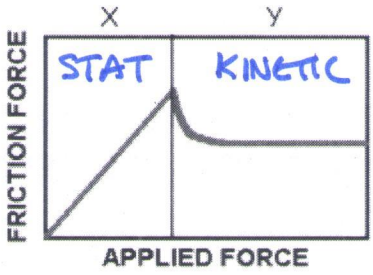
$(+80) + (-24) = (6+8)a$

$a = \frac{56}{14} = 4\ m/s^2$

$T = 80 - 8(4) = 80 - 32 = \boxed{48N}$

88%

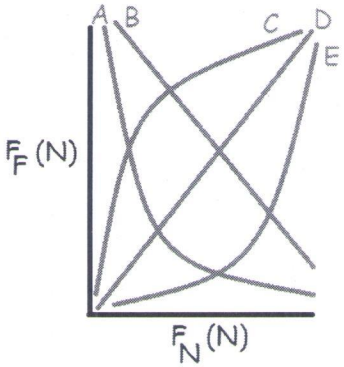
G2) Recalling the notes, which part of this diagram (X, or Y), refers to STATIC friction? (1pt)



X

88%

G3) Which trace best represents the relationship between Friction force and Normal force for an object that is moving? (1pt)



$F_F = \mu F_N$

Linear F_F vs F_N

D

G4) A 6 kg object hangs from a force gauge while travelling in an elevator that is moving upwards and slowing down. The magnitude of its acceleration is 4m/s^2. What is the apparent weight indicated by the scale?

37% (A) 24N ~~(B)~~ 36N (C) 60N (D) 84N

$\Sigma F_V = ma$

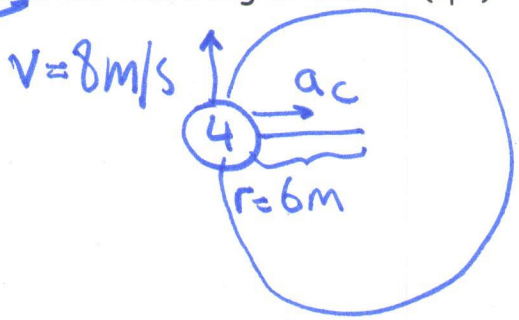
$T + (-60) = (6)(-4)$

$T = 60 - 24$

$T = 36N$

H1) What is the centripetal acceleration of a 4kg block that moves around a 6m radius circle while travelling at 8m/s? (1pt)

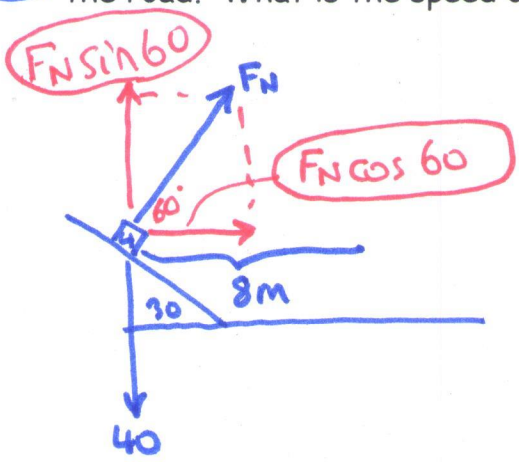
73%



$a_c = \frac{v^2}{r} = \frac{8^2}{6} = \frac{64}{6} = \boxed{10.67\ m/s^2}$

H2) A 4kg model car drives as fast as it can around a circular track of 8m radius. The track is banked at 30* and the car experiences no friction force between the model car's tires and the road. What is the speed of the model car? (1pt)

7%



$\Sigma F_{hor} = ma = ma_c = \frac{mv^2}{r}$

$F_N \cos 60 = \frac{(4)(v^2)}{8}$

$v^2 = \frac{8}{4} F_N \cos 60 = 2 F_N \cos 60$

$\Sigma F_{VERT} = 0$

$(F_N \sin 60) + (-40) = 0$

$F_N = \frac{40}{\sin 60} = 46.188$

sub back

$v^2 = 2(46.188)\cos 60 = 46.188$

$v = \sqrt{46.188} = \boxed{6.796\ m/s}$

H3) A particle has a tangential acceleration of 3m/s^2. It has a centripetal acceleration of 4m/s^2. What is its net acceleration? (1pt)

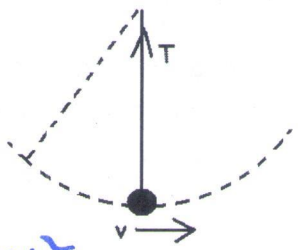
82%

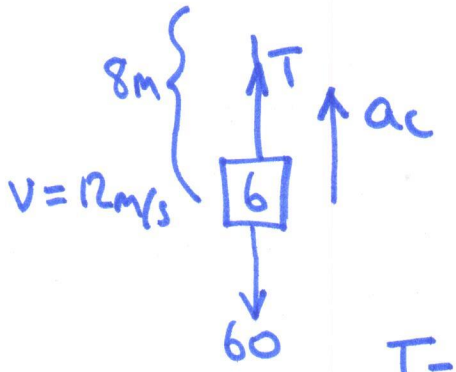
$a = \sqrt{a_t^2 + a_c^2} = \sqrt{3^2 + 4^2} = 5$

$\boxed{a = 5\ m/s^2}$

H5) A 6kg ball is attached to a ceiling by a rope that is 8m long. The ball is swung in an arc forming a pendulum. The speed of the ball at its lowest point is 12m/s. What is the tension in the rope at its lowest point? (1pt)

(46%)





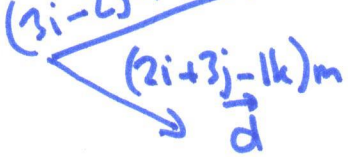
$\Sigma F_V = ma$

$(T)+(-60) = ma_c = \frac{MV^2}{r}$

$(T)+(-60) = \frac{6(12^2)}{8} =$

$T = \frac{6(12^2)}{8} + 60 = \boxed{168N}$

(61%) I1) A force of (3i-2j+1k)N moves through a displacement of (2i+3j-1k)m. How much work was done by this force? (1pt)

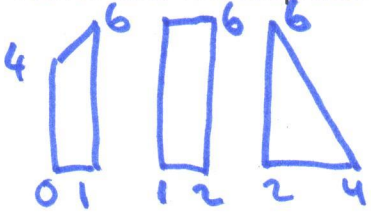


$w = \vec{F}\cdot\vec{d} = (3i-2j+1k)\cdot(2i+3j-1k)$

$w = (3)(2)+(-2)(3)+(1)(-1)$

$w = (6)+(-6)+(-1) = \boxed{-1J}$

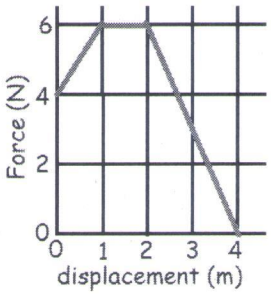
(58%) I2) How much work is done by this force during this journey? The force vector and the displacement vector point in the same direction. (1pt)



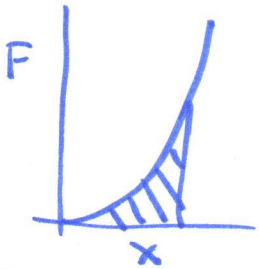
$w = \int F\,dx =$ area under graph

$w = \frac{1}{2}(4+6)(1) + (6)(1) + \frac{1}{2}(6)(2)$

$w = 5+6+6 = \boxed{17J}$



(49%) I3) A force acts on a 4kg particle. The force varies with position. The force is defined by $F=(x^2-5x+1)$, where F is in newton and x is in meters. The force vector and the displacement vector point in the same direction. How much work is done by this force between x=2m and x=4m? (1pt)



$w = \int F_x\,dx = \int x^2 - 5x + 1\;dx$

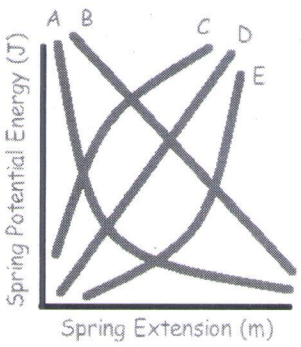
$w = \left[\frac{x^3}{3} - \frac{5x^2}{2} + x\right]_2^4$

$w = \left\{\left(\frac{64}{3} - \frac{80}{2} + 4\right) - \left(\frac{8}{3} - \frac{20}{2} + 2\right)\right. = \boxed{-9.33\,J}$

(76%) I4) White the three equations for mechanical energy.

Kinetic Energy	Gravitational Potential	Spring Potential
$U_k = \frac{1}{2}MV^2$	$U_g = mgh$	$U_s = \frac{1}{2}kx^2$

J1) A student plots a graph of spring potential energy versus spring extension. Which trace best represents the graph. (1pt)



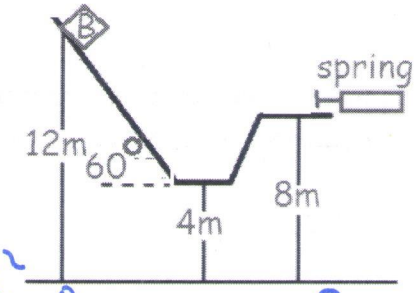
82%

$U_s = \frac{1}{2}kx^2$ U

U_s x E

J2) A 6kg block is released from a point that is 12m above the base of a frictionless track. The block slides along the track and eventually runs into a string buffer that brings the block to rest when the spring is compressed by 6m. What is the spring constant of the spring? (1pt)

43%



$M_A = M_B$

$\frac{1}{2}MV_A^2 + mgh_A + \frac{1}{2}kx_A^2 = \frac{1}{2}MV_B^2 + mgh_B + \frac{1}{2}kx_B^2$

$\frac{1}{2}(6)(0)^2 + (6)(10)(12) + 0 = 0 + (6)(10)(8) + \frac{1}{2}(k)(6^2)$

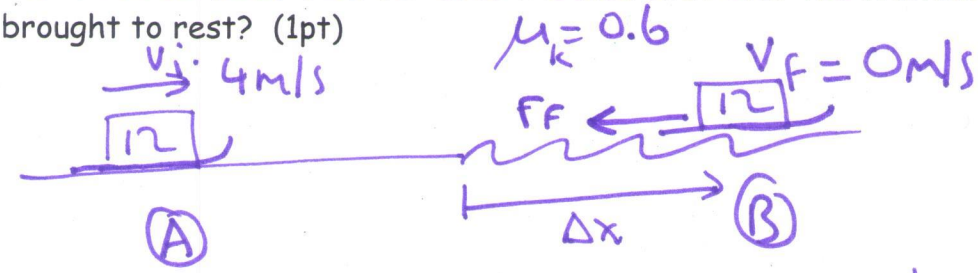
$720 = 480 + 18k$

$k = \frac{720 - 480}{18} = \frac{240}{18} = 13.33\ N/m$

J3) A 12kg sled slides across a smooth and level surface with a constant speed of 4m/s. It slides onto a friction-filled surface. There is a 0.6 coefficient of friction between the sled and the friction-filled surface. How far does the sled slide over the friction-filled surface before it is brought to rest? (1pt)

~~10%~~

55%



$F_F = \mu F_N$

$F_F = (0.6)(120)$

$F_F = 72.0\ N$

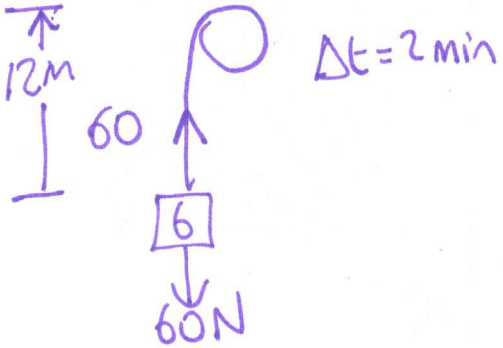
$\frac{1}{2}MV_A^2 + W_{FRICTION} = \frac{1}{2}MV_B^2$

$\frac{1}{2}(12)(4)^2 + (-72)(\Delta x) = 0$

$\Delta x = \frac{96}{72} = 1.33\ m$

88%

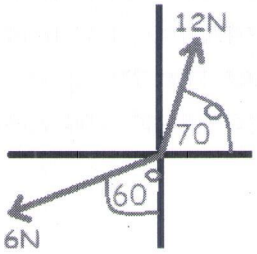
J4) A 6kg block is raised 12m vertically into the air by a motor. The task takes 2 minutes. If the system is perfectly efficient, what is the power of the motor? (1pt)



$$P = \frac{W}{\Delta t} = \frac{(F)(d)\cos\theta}{\Delta t}$$

$$P = \frac{(60)(12)\cos 0}{(2)(60)} = \boxed{6\ W}$$

EC1) Two forces act on a particle. Both forces act in the X-Y plane. Express the 6N vector in ijk notation.



52%

$$(-6\sin 60)i + (-6\cos 60)j$$

$$\boxed{-5.2i - 3.0j + 0k\ N}$$

EC2) Consider a force vector F=(4i+1j-3k) N. Write the expression for the unit vector that indicates the direction of this vector.

49%

$$\left[\frac{4i+1j-3k}{\sqrt{4^2+1^2+(-3)^2}}\right] = \left[\frac{4i+1j-3k}{\sqrt{26}}\right]$$

1) Express 43μg in SI units

79%

$$43\mu g \rightarrow 43\times10^{-6}\,g \rightarrow \boxed{43\times10^{-9}\,kg}$$

2) Express $44Gm^2$ in SI units

82%

$$44Gm^2 \rightarrow \boxed{44\times10^{+18}\,m^2}$$

3) Express $45nm^3$ in SI units.

79%

$$45nm^3 \rightarrow \boxed{45\times10^{-27}\,m^3}$$

4) Write the standard equation for the volume of a sphere.

67%

$$\boxed{V_{sphere} = \frac{4}{3}\pi r^3}$$

5) Write the standard equation for the circumference of a circle.

88%

$$\boxed{circ = 2\pi r}$$