SMILE!

PHYSICS IS FUN!!!

F is for force that moves things around

Physics Midterms Examples:
found at: http://www.phas.ubc.ca/~scione/SOP2014/practice.html

1) So it would form a motion diagram with the block spaced the same distance between each block as the velocity is constant as there is no resistance forces due to the surface being frictionless. The graphs: For displacement the graph would have the equation y=nx where n is dependent on the velocity of the block. For velocity it would be a straight line at the initial velocity on the y axis. For acceleration it is the x axis, as there is no acceleration as the velocity is constant.

2) Graph of x position starts as a y=nx line then becomes a y=x^2 curve increasing the gradient and then it will return to being linear y=mx but with a steeper gradient i.e m>n

I think the position is just y=nx because we are only looking at the x-direction, But it is going to accelerate down the ramp so will not be linear function for that instance. I agree. but would it get steeper? covering more distance in less time. After is has accelerated down the ramp it will maintain constant velocity which will be greater than before the ramp and so will have a steeper linear graph.

The velocity graph will be a line parallel to the x axis at whatever the initial velocity is(I am assuming it is starting with some velocity) and then the velocity will increase linearly and then return to linear when it hits the bottom of the slide.
The acceleration will be 0 until it hits the top of the ramp and then will jump to being parallel to the x axis when the block starts down the slide, then will return to 0 when the block hits the bottom of the slide.
so would velocity be increasing linearly or like y=x^2 when it goes down the ramp? ANYONE?

Velocity will be constant (a line parallel to the x-axis) then velocity will increase (y=nx) then parallel to x-axis again.
wont it increase more (as in not linearly) as it picks up speed down the ramp tho?
.
i think it wud pick up speed down the ramp, cos its a frictionless ramp...

3) For the y position graph, assuming you take the starting position as 0 at t=0 and take the downward direction as positive then the graph will increase in a convex fashion until it hits the terminal velocity at which point the graph will continue in a linear fashion.
For the velocity it will start convex, then will become concave until it is parallel with the x axis when it hits terminal velocity.
For the acceleration it will start at 9.8 on the y axis then begin in a concave fashion then become linear and then convex as the object reaches terminal velocity and will be 0 at terminal velocity.

4) It is stationary for a time then moves in the positive direction (let's say right) at a constant velocity and then it stops.

5) It will move in the positive direction at a constant speed and then will begin to accelerate with constant acceleration and then will continue at in the positive direction at a constant speed at the end of the acceleration.

6) The object experiences constant acceleration in the positive direction. The acceleration increases and then becomes constant. Nothing conclusive can be known about its velocity or position.

7)
X(t)
Straight line of linear slope, curved line, straight line. All positive quadrant, all moving in positive direction for both axes.

a(t)
Zero for first ⅓ of motion. Random jump to some constant positive acceleration. Random jump back to zero again.

8) So today Mark said you would pick a part of the graph and then describe what mathematical equations would go with it for position, acceleration, and velocity (ex. x^2, mx+b ect.) and then repeat with the other sections.

9) x(t)= -5t^3 x(2)= -40m
v(t)= -15t^2 v(2)= -60m/s
a(t)= -30t a(2)= -60m/s^2

10) x(5) = 15 m
v(5) = 5 m/s
a(5) = 0 m/s^2

11) The instantaneous velocity at 5s will be greater than the average over the first 5s as the velocity is determined by the gradient of the position time graph and the gradient at 5s is greater than any of the gradients at any times prior to 5s.

12) Average velocity=0.2m/s
Instantaneous velocity: (Not entirely sure about this but we are told it is a parabola so we could write the equation of the curve as y=nx^2 and we know a coordinate (5,1)
so n=1/25 so the equation is now y=1/25x^2.

Differentiate to get y'=2/25x and sub in x=5 to get the instantaneous velocity of 10/25 m/s.
I feel like I am forgetting a way of doing this that is much simpler???? Anyone???
Me tooooo
I did this the same way as you, I don't think there is a simpler way.

13) V=dx/dt => (4.72-4.32)/0.02 = 20m/s velocity at 0.05s
(4.98-4.50)/0.02 = 24m/s velocity at 0.06s
A=dv/dt => (24-20)/0.01 = 400m/s^2

13.5) Px= (mvx1)+(mvx2)= (10cos30)(1) + (30cos45)(2) = 51 kgm/s (with subtraction= 33.77 kgm/s)
(shouldn't it be a minus instead of a plus? because the second ball is moving towards the first ball. therefore, the answer will be -33.766 kgm/s) <- that's what I got I assumed they were heading in the same direction. Its not totally clear if they are heading in opposite directions. Also when they say 45 degrees above the horizontal they usually mean from the positive x axis so for it to be heading in the opposite direction it would say 135degrees above the horizontal. If something like this comes up on the exam, I would just state your assumptions… Yeah and draw a diagram showing what you are assuming. The exam is to test your ability to crunch the numbers, so I think it would still give you most of the marks even if its a bit ambiguous as to which direction. that makes a lot of sense. thanks for clarifying that up :)

"moves towards it" i.e. on a collision course, so you have to make the x component for one of them negative. Does not necessarily mean in the opposite direction to. I can draw a picture showing it moving in the same positive direction.
Py= (mvy1)+(mvy2)= (10sin30)(1) + (30sin45)(2) = 47.4kgm/s

13.6)Use our pea shooter which fires peas of a certain mass at a certain velocity at the two objects of different mass, lets say one is m and the other is 2m and it is a fully elastic collision i.e. the pea rebounds at the same speed at which it hit the object. Then the mass of the objects can be compared as the velocity of the rock with the greater mass will have half the velocity of the other rock as the momentum change is the same for both so mv1=2mv2 which when rearranged gives v2=1/2v1. You can use this method to compare two different objects masses in space.

14)

15) The position 10 seconds later is going to be 52m as the velocity will remain the same over that time (t) as momentum (p) is conserved because in outer space there is no resistance and the mass of the object is not going to change so the velocity is going to be the same until something exerts a force on it. Therefore the velocity at 10s will be 5m/s.

16) Inelastic collision: p = 10 kg m/s, v = 2.5 m/s
Elastic collision.. do we need more info? or work with the equations from highschool.. vf = m2-m1/m1+m2 etc...

17) v = 3.33 m/s

18) v = 2.5 m/s

19) Momentum is conserved in both the x and y direction. So Px initial= 10
Therefore 10= (5cos45)(1) + 3(vcosx) (being the angle from the horizontal)
vcosx=2.15
Py initial= 0
0=(5sin45)(1) + (3)(vsinx)
vsinx= -1.178

vsinx/vcosx=tanx => tanx= -1.178/2.15 x=-28.7 degrees

Therefore v=2.15/cos(-1.178) = 2.45m/s in a direction which is 28.7 degrees below the horizontal.

20) They have the same momentum as the tennis balls are the same mass and velocity so they both have the same momentum prior to collision and they rebound at the same speed so they have the same momentum after the collision. Therefore the change in momentum will be the same for the wood and the gold, however the wood will move with a greater velocity than the gold because gold is denser therefore as they are the same volume the gold will have greater mass.

21) The rate of change in momentum should be the same for both the wood and the gold block. Since each tennis ball would result in the same change in momentum, as discussed in the previous question, changing the frequency at which this change in momentum is applied

will not alter the change itself.

22) From what I expect, the graphs should be identical, given that force is defined as the change in momentum over time. (Can anyone refute this? Is it that simple?)
This is making the assumption that the car exists in a momentum-conserved system (no friction) I don't think so. Acceleration would remain constant as the car accelerates, while momentum would simply be velocity times mass (a constant) - momentum would then be partially reliant on the graph of velocity over time.
The graph of force will be similar to the graph of acceleration (the only difference is the constant m) and the accel. graph you can find by taking the derivative of the velocity graph. The graph of change in momentum is similar to the graph of velocity- change in momentum graph is the integral of the graph of force so it will take the same shape as that of velocity

23) 4.5N

24) The force graph will be a linear line up until the ball is released and then it will drop to zero as the ball is flying through the air. Then when it hits the wall it will decrease linearly below the x axis until the ball leaves the wall and is flying back in the other direction at which point the force graph returns to zero. The impulse graph will be a convex curve to start with as the ball is accelerating so the change in velocity will accelerating. Then when the ball is released the impulse graph will be a straight line parallel to the x-axis as the ball is moving with constant velocity. When it hits the wall it will decrease in a concave fashion until the ball leaves the wall where it will return to being parallel to the x-axis. Question: would the impulse graph return to zero after the ball hits the wall as momentum is supposed to be conserved?
I think theimpulse graph will never be zero because it is asking for the cumulative impulse Ok, but the impulse would be negative as the ball moves backwards, no? So adding to the other and cancelling out? Yes it would
shouldnt the force graph be like 0000000spike000000? cuz the acceleration(x) is 0, and only during the second of impact theres a change in force?
25) Force=change in momentum. If this new force doesn't follow N's3rdL where a force from an object acting on another is equal to the force of the second object upon the first, then the change of momentum of one object would not be equal to the change in momentum of the other object. As a result momentum is not conserved.

25.5) B and C. Not A because there is an external force (friction) acting upon the system and so momentum is no longer conserved.

26) Fd= Drag force, Vx, Vy, let Q be angle of Vtot relative to axes

Fdx=Fd(cosQ)=-mDVx\sqrt(Vx^2+Vy^2)
Fdy=Fd(sinQ)=-mDVy\sqrt(Vx^2+Vy^2)

Ie. Because sinQ=Vy/Vtot
And Vtot=sqrt(Vx^2+Vy^2)

(Hopefully this makes sense)

27)

ax=(1/m)Fd(Vx/sqrt(Vx^2+Vy^2))
ay=(1/m) (-9.8m+Fd(Vy/sqrt(Vx^2+Vy^2)) ←-- does it ask for force?

→ The equations above shouldn't have the 1/m term; the force equations have an m term, but a=F/m, so the m should cancel out (the force equation in navy blue below looks right).

OR
Fx = Dm (Vx)^2
Fy = Dm(Vy)^2- m9.8

I thought it was Fx= -(Dvx)/Sqrt(vx^2+vy^2)
Fy= -(Dvy)/Sqrt(vx^2+vy^2) - mg

I thought Fx = -m*D*Vx*sqrt(Vx^2+Vy^2), which you multiply by the square root (rather than divide in the previous examples?

It says the drag force is speed-independent for this question.
It ends up being Dx = D * (vx/ v) and Dy = D*(vy/v)

28)

dvx/dt=(1/m)Fd(Vx/sqrt(Vx^2+Vy^2))
dvy/dt=(1/m) (-9.8m+Fd(Vy/sqrt(Vx^2+Vy^2))

This seemed like the same question twice...is there something I'm missing here? I think what you have here is 29, while 28 would be the same thing, but for force, so you would not divide by m.

29) Euler's method, by definining F= dp/dt, assuming mass is constant you get m*dv/dt. dv/dt allows you to find V(t+small change), which allows you to find

30)

ax=-14.4m/s^2

vx=-0.144m/s
x=2.99m ← I'm getting 3.12m from d(0)=3 + (delta-t)(vt)=(.01)(12)

ay=-0.3m/s^2
vy=11.997m/s
y=0.12m

^

Got same answer :) ← EDIT: The person who posted below me is correct. I accidently plugged in Vx at t= 0.01 instead of Vx at 0.

According to the notes (lecture 8) isn't the formula for find x at 0.01 is x(t+dt) = x(t) + v(t)dt, which results in the x-position still being 3 (using Euler's method to do the estimate)... Is this right or not? (and why?) - the actual position would be just less than three, but using Euler's method we should get x(0.01) = 3

^

31) anyone working on this right now?
jkkkk i talked to james he said this question wouldn't come up on the midterm (but maybe would be useful to know for math!!)

Y=Acos(sqrt(0.49)t) + Bsin(sqrt(0.49)t) + C
take second derivative of Y(t), it becomes equal to -0.49Y-9.8
then -4.9c-9.8=0
c=2
now look at the signs in front of A and B: whatever sign is in front of A on the left equation is equal to that in front of A on the right equation:
-Aw^2=-4.9A
-Bw^2=-4.9B
w=4.9^(½)
plug w and c into the original equation, derive, and plug into derivative

32) Assume the mass (not given) is 100 kg. Yeah, I was struggling with this one, we need the mass for this question right?
Yeah the only way I know how to do it is with mass anybody know how to do it without?

I did it without finding c because I couldn't find c, not knowing mass.

a(t) = F/m = 10000 t^3 /100 = 100 t^3
v(t) = integral of a(t) = 25 t^4 + c
v(1) = 20 = $25(1)^4$ + c
c = – 5
v(t) = $25t^4$ – 5
v(3)=2020m/s
x(t) = definite integral of 25t^4-5, which becomes $5t^5$ – 5t + c (evaluate from 1 to 3)
x(3) – x(1) = $5(3)^5$ – 5(3) – [$5(1)^5$ + 5(1)] ← why is it 5x^5+5x ← because that is the integral of the velocity = 25^4-5
x(3) – x(1) = 1200 m.

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