Notes for physics UTS midterm exam:

s is your student number.

k = s mod 10000

T = s mod 100

m = s mod 35

L = s mod 10 = m10

1. How many significant figures are there in your T number?

Your T is between 1 and 99, so there will be 1 or 2 significant figures.

Use the Atlantic Rule to find the number of significant figures of your T number.

2. Find velocity and acceleration for motion with equation x = -k + Lt + Tt2.

Take the first derivative to find the velocity.

Take the second derivative to find the acceleration.

3. Calculate the final speed after absolutely inelastic collision of two balls of masses L kg and T kg, moving with velocities s meters per second and k metres per second respectively.

s = 22123456

k = s mod 10000

T = s mod 100

L = s mod 10

u1 = s

u2 = k

m1 = L

m2 = T

v = (m1 \* u1 + m2 \* u2) / (m1 + m2)

MsgBox v

MsgBox “Velocity is measured in meters per second.”

MsgBox “Maximum number of significant figures is 1.”

4. Solve the elastic collision problem for u1 = k, u2 = k/2, m1 = k, m2 = 2k.

s = 22123456

k = s mod 10000

T = s mod 100

L = s mod 10

u1 = k

u2 = k/2

m1 = k

m2 = 2\* k

'

v1 = ((m1 - m2) \* u1 + 2 \* m2 \* u2) / (m1 + m2)

v2 = v1 + u1 - u2

'

MsgBox v1

MsgBox v2

MsgBox “Velocity is measured in meters per second.”

MsgBox “Maximum number of significant figures is 4.”

5. Find the centre of mass of 2 equal masses k meters apart.

s = 22123456

k = s Mod 10000

centerOfMass = k / 2

MsgBox centerOfMass

MsgBox “Location of centre of mass is measured in meters”

MsgBox “Maximum 4 significant figures”

Question:

Find Maximum x, Maximum y; find x and y at time = T seconds, for angle of release A = T degrees, initial velocity V0 = T meters per second, x0 = y0 = 0 meters for projectile.

s = 22123456

T = s Mod 100

v0 = T

g = 10

Pi = 4 \* Atn(1)

A = T \* Pi / 180

x0 = 0

y0 = 0

x = x0 + T \* v0 \* Cos(A)

y = y0 + T \* v0 \* Sin(A) - g \* T / 2

MsgBox x

MsgBox y

xmax = v0 ^ 2 \* Sin(2 \* A) / g

ymax = v0 ^ 2 \* (Sin(A)) ^ 2 / (2 \* g)

MsgBox xmax

MsgBox ymax

MsgBox “Distance is measured in meters.”

MsgBox “1 or 2 significant figures for x”

MsgBox ”1 significant figure for y, xmax, ymax.”

Question:

Find minimum velocity and corresponding angle of release of projectile to hit the point (s, T).

$$T\_{1,2}=\frac{y\mp \sqrt{x^{2}+y^{2}}}{x}$$

' minimum velocity for projectile

x = 11

y = 2.5

g = 10

T1 = (y + Sqr(x \* x + y \* y)) / x

T2 = (y - Sqr(x \* x + y \* y)) / x

'MsgBox T1

'MsgBox T2

v1 = Sqr(g \* x ^ 2 \* (1 + T1 ^ 2) / (2 \* (x \* T1 - y)))

MsgBox v1

'v2 = Sqr(g \* x ^ 2 \* (1 + T2 ^ 2) / (2 \* (x \* T2 - y)))

'MsgBox v2

MsgBox Atn(T1) \* 180 / (4 \* Atn(1))

'MsgBox Atn(T2) \* 180 / (4 \* Atn(1))

MsgBox “Velocity is measured in meters per second.”

MsgBox “Angle is measured in degrees.”

MsgBox “1 significant figure”

calculus12s.weebly.com/uploads/2/5/3/9/25393482/velocity4minimum4projectile.txt

6. Find the acceleration of a simple pulley and tension in the rope for two masses: L kg and T kg.

s = 22123456

k = s Mod 10000

T = s Mod 100

L = s mod 10

g = 10

m1 = L

m2 = T

a = (m2 - m1) \* g / (m1 + m2)

tt = m1 \* (g + a)

tt = m2 \* (g - a)

MsgBox a

MsgBox “Acceleration is measured in meters per second squared.”

MsgBox tt

MsgBox “Tension is measured in Newtons.”

MsgBox “1 significant figure”

youtube.com/watch?v=kvCnjVSpuv0

7. Find gravity acceleration g, orbital velocity Vo and escape velocity Ve for planet with mass s billion tons and radius s millimetres.

s = 22123456

GG = 6.6740831 \* 10 ^ (-11)

M = 10 ^ 12 \* s

R = s / 1000

g = GG \* M / R ^ 2

MsgBox g

MsgBox “Acceleration g is measured in meters per second squared.”

Vo = Sqr(g \* R)

MsgBox Vo

Ve = Sqr(2 \* g \* R)

MsgBox Ve

MsgBox “Velocity is measured in meters per second.”

MsgBox “7 or 8 significant figures”

8. Find acceleration of a mass at the inclined plane with

A = T degrees and the friction coefficient μ = 1/T.

s = 22123456

T = s Mod 100

Angle = 4 \* Atn(1) \* T / 180

g = 10

mu = 1 / T

acceleration = g \* (Sin(Angle) - mu \* Cos(Angle))

MsgBox acceleration

MsgBox “Acceleration is measured in meters per second squared.”

MsgBox “1 significant figure”

youtube.com/watch?v=8xOU25PWx8M

9. Find the hangover for the s blocks in the blocks stacking problem.

s = 22123456

h = 0

For k = 1 To s

h = h + 1 / k

Next k

ho = h / 2

MsgBox ho

MsgBox “Hangover is measured in meters.”

MsgBox “7 or 8 significant figures.”

youtube.com/watch?v=Gaua\_V9Fse4

10. Find angular velocity and linear acceleration for v = T meters per second and R = k meters.

s = 22123456

L = s Mod 10

T = s Mod 100

k = s Mod 10000

v = T

R = k

omega = v / R

a = R \* omega ^ 2

MsgBox omega

MsgBox “Angular velocity is measured in radians per second.”

MsgBox a

MsgBox “Linear acceleration is measured in meters per second squared.”

MsgBox “Maximum 2 significant figures.”

11. Calculate the Schwarzschild radius for the k grams desk.

s = 22123456

k = s Mod 10000

T = s Mod 100

c = 2.99792458 \* 10 ^ 8

G = 6.67408 \* 10 ^ (-11)

M = k \* 10 ^ (-3)

Rs = 2 \* G \* M / c ^ 2

MsgBox Rs

MsgBox “Radius is measured in meters.”

MsgBox “Maximum 2 significant figures.”

Question:

Are black or white clothes warmer? Why?

White clothes keep the temperature the same. Black clothes cause heat exchange.

Human body temperature is about 37 degrees, average temperature on Earth is about 15 degrees, so, on average, on Earth, white clothes are warmer than black clothes.

12. Calculate Doppler effect for sound.

Frequency changed; wavelength changed from 17 meters to 16 meters because of the speed of the source of sound.

Which direction does the source of sound move?

Frequencies:

f = c/BIG\_Wave\_Length

F = c/small\_wave\_length

f = Fc/(c+v)

v = -c + Fc/f

BIG\_Wave\_Length = 17

small\_wave\_length = 16

' c is speed of sound

c = 343

f\_small = c / BIG\_Wave\_Length

F\_BIG = c / small\_wave\_length

wavelengthchange = BIG\_Wave\_Length - small\_wave\_length

MsgBox wavelengthchange

v = -c + c \* F\_BIG / f\_small

MsgBox v

MsgBox “Velocity is measured in meters per second.”

MsgBox “2 significant figures.”

13. There are two bodies in a thermodynamically isolated system: C1 m1 T1 and C2 m2 T2.

Find the resulting temperature T. m1 = k, m2 = 2k. C1 = k/11, C2 = k/222, T1 = k/111, T2 = k/22

s = 22123456

k = s Mod 10000

'

m1 = k

c1 = k / 11

t1 = k / 111

'

m2 = 2 \* k

c2 = k / 222

t2 = k / 22

'

t = (t1 \* c1 \* m1 + t2 \* c2 \* m2) / (m1 \* c1 + m2 \* c2)

MsgBox t

MsgBox “Temperature is measured in Kelvins.”

MsgBox “3 or 4 significant figures.”

14. Find the force between two charges of L and T Coulombs, m meters apart.

s = 22123456

T = s Mod 100

m = s Mod 35

L = s Mod 10

charge1 = L

charge2 = T

Coulomb\_constant = 10 ^ 10

Coulomb\_force = Coulomb\_constant \* L \* T / m ^ 2

MsgBox Coulomb\_force

MsgBox “Force is measured in Newtons.”

MsgBox “1 significant figure.”

15. Calculate the series and the parallel circuits with e.m.f. of T Volts and the resistors L+1, 2 and 3 ohms respectively.

s = 22123456

T = s Mod 100

L = s Mod 10

emf = T

V = emf

R1 = L + 1

R2 = L + 2

R3 = L + 3

' For series circuit:

R = R1 + R2 + R3

current\_I = V / R

MsgBox current\_I

V1 = current\_I \* R1

V2 = current\_I \* R2

V3 = current\_I \* R3

MsgBox V1

MsgBox V2

MsgBox V3

MsgBox “Voltage is measured in Volts.”

' For parallel circuit:

R = R1 \* R2 \* R3 / (R1 \* R2 + R1 \* R3 + R2 \* R3)

MsgBox R

MsgBox “Resistance is measured in Ohms.”

current\_I = V / R

MsgBox current\_I

current\_I1 = V / R1

current\_I2 = V / R2

current\_I3 = V / R3

MsgBox current\_I1

MsgBox current\_I2

MsgBox current\_I3

MsgBox “Current is measured in Ampers.”

MsgBox “1 significant figure”

16. Show that Maximum loss in circuit with internal resistance r and external resistance R is when R = r.

E = I(R+r)

waste = RI2.

Take derivative, equate it to zero and find the Maximum.

$$I=\frac{E}{R+r}$$

$$RI^{2}=\frac{RE^{2}}{\left(R+r\right)^{2}}$$

Take derivative, equate it to zero and find the Maximum.

derivative-calculator.net

$$\left(RI^{2}\right)^{'}=E^{2}\frac{\left(R+r\right)^{2}-2R(R+r)}{\left(R+r\right)^{4}}=E^{2}\frac{r-R}{\left(R+r\right)^{3}}=0$$

R = r for maximum waste (loss).

We found maximum loss (waste) when R = r because minimum loss (waste) is when R = 0.

17. Find the frequency and the period of the harmonic oscillator. L = k μH and C = T μF.

s = 22123456

k = s Mod 10000

T = s Mod 100

L = k \* 10 ^ (-6)

C = T \* 10 ^ (-6)

omega0 = 1 / Sqr(L \* C)

MsgBox omega0

MsgBox “Angular frequency omega0 is measured in radians per second.”

MsgBox “1 or 2 significant figures”

pi = 4 \* Atn(1)

period = 2 \* pi / omega0

MsgBox period

MsgBox “Period is measured in seconds.”

MsgBox “1 or 2 significant figures”

18. Find V1 for the transformer if V2 = T volts, N1 = k and N2 = s.

s = 22123456

k = s Mod 10000

T = s Mod 100

V2 = T

N1 = k

N2 = s

V1 = -V2 \* N1 / N2

MsgBox V1

MsgBox “Voltage is measured in Volts.”

MsgBox “1 or 2 significant figures”

Question:

What colour is the Sun? Why?

Sun is green, we can observe that and we can calculate the frequency of the radiation from the Sun, using temperature of the Sun.