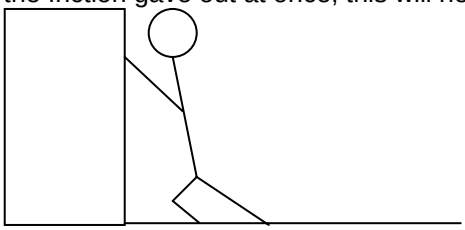
Sph4u **Final Exam Review**

Useful constants

$$m_{electron} = 9.11\times10^{-31}\,kg \qquad e^{-} = -1.60\times10^{-19}\,C \qquad k = 9.0\times10^{9}\,N\cdot m^2/C^2 \text{ or } = 2.306\times10^{-28}\,N\cdot m^2/e^2$$

$$G = 6.67\times10^{-11}\,N\cdot m^2/kg^2 \qquad M_{earth} = 5.98\times10^{24}\,kg \qquad R_{earth} = 6.38\times10^{6}\,m$$

1. A sky diver jumps from a plane: sketch a graph representing the divers velocity vs. time if
   a) There is no air resistance
   b) When there is air resistance
2. A high school student attempting to recreate the genius of the makers of Jackass decides to go shopping chart surfing. The 70kg student, running at a speed of 2.0m/s, jumps on a 5.0kg cart. Determine the velocity of the cart if.
   a) The student successfully lands on the shopping chart
   b) The student smacks into the cart, dings his head off the handle, hits the ground like a tonne of bricks, but manages to impart 70% of his kinetic energy to the cart
3. Come up with three examples of a body in equilibrium.
4. A rope can withstand a maximum tension of F and is oscillating at a frequency of 2.0Hz. What would be the maximum frequency if the length of the rope was doubled?
5. Draw a sketch of the transmission of a pulse moving from a fast medium to a slow medium and vice versa.
6. A car drives 20km [W], 10km [S], 5 km [SW] find the displacement
7. Sketch the direction of all the forces acting on the stick person below. Clue consider what would happen all the friction gave out at once, this will help you determine the direction of the forces.

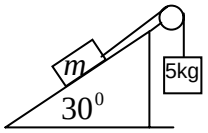


8. Define simple harmonic motion and give 3 examples.
9. Two identical charge spheres of identical charge are separated by a distance of R, if the charges on each are doubled but the separation distance is tripled,
   a) what happens to the force between them?
   b) If a third identical neutral charge comes in contact with one of the spheres but not the other what happens to the force in part a)
10. Summarise Kepler's laws.
11. How much must a curve be banked on a highway if the radius of the curve is 200m and the velocity of the car is 72km/h such that the car requires no friction to stay on the road.
12. A 4.0m wood plank of mass 5kg has two masses attached at each end. One mass is 10kg and the other is 20kg. Find the balance point of the system.
13. What is the definition of a wave? How is the frequency of a wave affected by a change in medium? What type of waves can travel through a medium? What is the relationship between frequency, velocity and wavelength?
14. In a strongman competition, the contestants are required to push two cars lined up bumper to bumper. If the car in front has a mass of 1500kg and the other car has a mass of 1000kg, find the action reaction force between the two cars if the acceleration of the cars is 1.0m/s^2

15. How much height does a 20kg mass gain if it is launched straight up with initial E_k of 1000J?

16. An electron is place between two electric plates with a potential difference of 200V. What is the final velocity of the electron when it hits the positive plate?

17. If the coefficient of static friction is 0.2 and the pulley is frictionless, find



a) The maximum mass of the block on the incline before in begins to slide down.

b) The minimum mass of the block on the incline before is begins to slide up.

18. Find the force of gravity exerted on a 10000kg satellite that is located 20 000km above the Earth's surface? What is the period of rotation at that point?

19. Find the acceleration of a car that is driving at a constant speed of 108km/h but is turning on a circular bend of radius100m, with an initial direction of due north to due west.

20. A spring-loaded cannon sits at the edge of a cliff, 100m above the ground. A 1.0kg coconut is placed in the cannon. The spring of the cannon has a force constant of 1500N/m. The spring is compressed by 30cm, find:

a) The muzzle velocity of the coconut as it is fired horizontally from the cannon.

b) The fall time of the coconut.

c) The range (horizontal displacement) of the coconut.

21. Based on question 16)

a) How much energy was given to the electron by time it reached the positive plate?

b) If the plates were separated by 10cm

i) Find the electric field strength between the plates

ii) The net force acting on the electron

iii) The acceleration of the electron

22. A 2000kg car driving at 72km/h [W], if forced to come to an immediate stop. The brakes apply a stopping force of 10000N

a) What is the acceleration of the car, expressed as a vector?

b) What is the velocity of the car after 2 seconds?

c) How much time will it take for the car to stop?

d) How far does the car travel before it stops?

23. From the diagram below, determine the

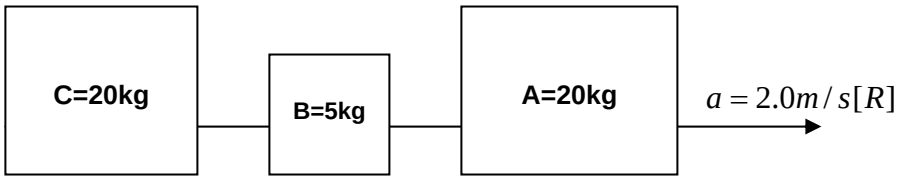
a) T

b) F_{AonB}

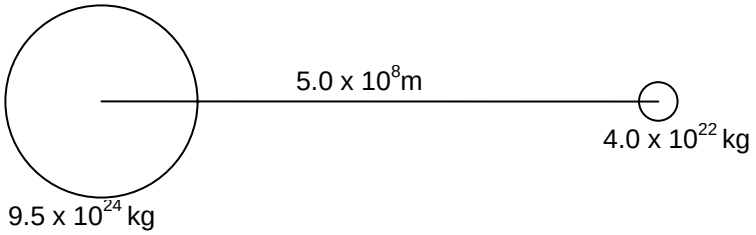
c) F_{BonA}

d) F_{ConB}

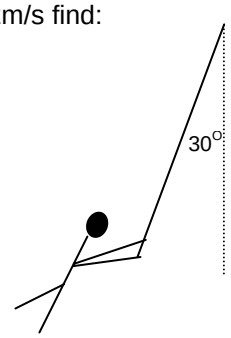
e) F_{BonC}



24. Find the distance "**d**" from the plant where a space ship of mass "**m**" will be in a state of equilibrium between the planet and its moon?

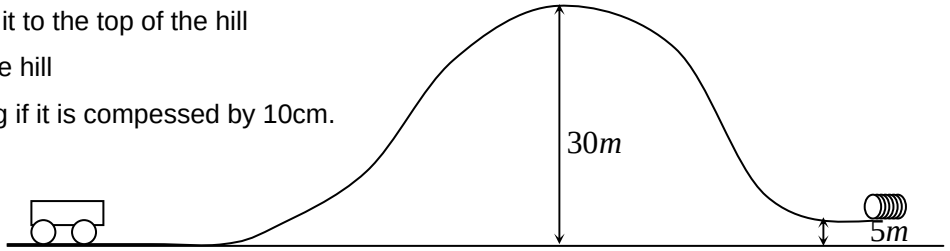


25. An 80kg Tarzan wanna' be swings on along a vertical arc. The length of the vine is 10m and makes an angle of 30^0 with the vertical. If his speed at that point along the arc is 12m/s find:



a) The centripetal acceleration at that instant.
b) The component of the force of gravity along the tangent
c) The acceleration due to gravity along the tangent
d) The component of the force of gravity along the rope
e) The tension in the cord.

26. A 10kg cart is given a solid push at the bottom of a frictionless hill. Find



a) The initial velocity to just make it to the top of the hill
b) The velocity at the bottom of the hill
c) The force constant of the spring if it is compessed by 10cm.

27. A 30 kg kid standing on a remarkably frictionless skateboard, of mass 2.0kg, throws a 500g basketball towards a wall that is 2.0m away at a speed of 5.0m/s. Find
    a) The velocity of the boy immediately after he throws the ball
    b) The velocity of the ball after it hits the wall assuming a perfectly elastic collision
    c) The velocity of the boy after he catches the ball after it bounces back.

28. Monochromatic light from a point source illuminates two narrow parallel slits. The centres of the slits are 0.60mm apart. The light from the two parallel slits is projected on a screen 1.0m away. If the distance between three interference dark fringes is 0.90mm apart
    a) Determine the wavelength of the light
    b) What would be the separation of the nodal lines if the centres of the slits were narrowed to 0.3mm.

29. Two objects, identical mass, are on a collision course. Object A is moving at 10.00 m/s [E] and Object B is moving south at some unknown velocity. If the two objects stick together during collision and move off at an angle of $[E50.00°S]$:
    a) Find the velocity of object B pre collision.
    b) Find the velocity of both objects post collision.