National JC Physics Year 1
2003 Nov/Dec Holiday Assignment

For the students……..

Pace yourself during the holidays to catch up with first your topics in order to work on your area for improvements and to revise what you already knew. Hints and partial solutions to the questions will be uploaded to the NJC Physics website regularly. So update yourself according to the schedule shown in the table below.

Students will have to hand in the holiday assignments to your Physics tutor on ***5 Jan 2004*** *when your senior year starts.*

Topic	Hints/Partial solutions will be uploaded on …
Motion in Circle	**12 Dec 2003**
Gravitational Field	
Physics of Fluids	
Oscillations	**19 Dec 2003**
Waves	
Superposition	
Ideal Gas	**2 Jan 2004**
Data Analysis Question	

Self-reflection……

Thus reflect upon yourself and the recent Promotional examinations to identify your area for improvements, be it your studying techniques or gaps in your understanding of certain topics. Take this assignment as one small step in your preparation for the 'A' Level Examinations. Yes! It's not too early to start now as there is one such saying:

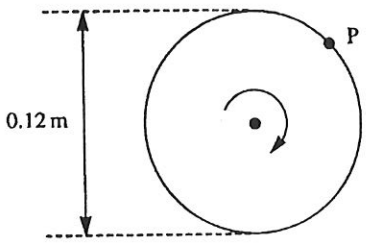
"A victory is never won during the battle but before the battle!"

National JC Physics Year 1
2003 Nov/Dec Holiday Assignment

Topic	MCQs	Short Structured	Long Structured
Motion in Circle	**TYS** Q4, 5 pg 79 Q28 pg 83 J01 P1 Q8 pg 397 N01 P1 Q8 pg 413	**TYS** J01 P2 Q3 pg 401 See Additional Question 1	See MC2
Gravitational Field	**TYS** Q7, Q9 pg 87 Q23 pg 89 Q38, Q45 pg	See Additional Questions 1, 2 and 3	-
Physics of Fluids	**TYS** J00 P3 Q10a, b pg 370 J01 P3 Q10 pg 408 N02 P3 Q10, 11 pg 454		
Oscillations	**TYS** Q6 pg133 Q20 pg135 Q35 pg137 Q38 pg138 Q81, Q82 pg145	**TYS** Q101, pg 105 See Additional Question 1	-
Waves	**TYS** Q13 pg 152 Q16, Q22 pg 153 Q25 pg 158 Q68 pg 160	**TYS** Q33 pg 155 Q40 pg 157	-
Superposition	**TYS** Q1, 2, 3, 4, 5, 7, 8, 9, 11, 12 pg 161 Q2, 4, 5, 7, 8, 9, 11, 14, 17, 18 to 23 pg 169 Q4, 5, 6, 8, 9 pg 175 J02 P1 Q28, 29 pg 431 N03 P1 Q16 pg 445	**TYS** Q30 pg 172 Q44 pg 174 N01 P2 Q5 pg 418 J02 P2 Q7pg 434 N02 P2 Q5 pg 448	
Ideal Gas	**TYS** Q13 pg107 Q30, Q33 pg 109 Q42, Q43 pg 110 Q26 pg 400	See Additional Question 1	**TYS** N02 P3 Q3 pg 452
Data Analysis Question	**TYS** Q13, pg 344 Q14, pg 345 Q17, pg 347 Q21, pg 351 Q9, pg 419		

Motion in Circle
Additional Question 1

A grinding wheel of diameter 0.12 m spins horizontally about a vertical axis, as shown in the diagram. P is a typical grinding particle bonded to the edge of the wheel.



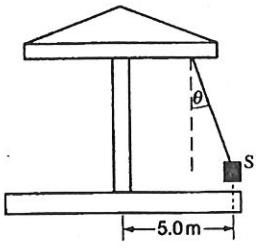
a. If the rate of rotation is 1200 rpm, calculate
   i. the angular velocity,
   ii. the acceleration of P,
   iii. the magnitude of the force acting on P if its mass is 1.0×10^{-4} kg.

b. The maximum radial force at which P remains bonded to the wheel is 2.5 N. Calculate the angular velocity at which P will leave the wheel if its rate of rotation is increased.

Additional Question 2

a. Write down an expression for the force needed to maintain a particle of mass m moving in a circular path of radius r at an angular velocity ω. State the direction of the force.

b. A seat S is suspended from a fairground ride by an inextensible rope. When the ride rotates at an angular velocity of 1.2 $rads^{-1}$, the rope makes an angle of θ with the vertical. The distance of S from the axis of rotation is 5.0 m.



   i. The tension in the rope is T. Explain how a component of T provides the force needed to keep S in a circular path and equate this component with the expression given in part a.

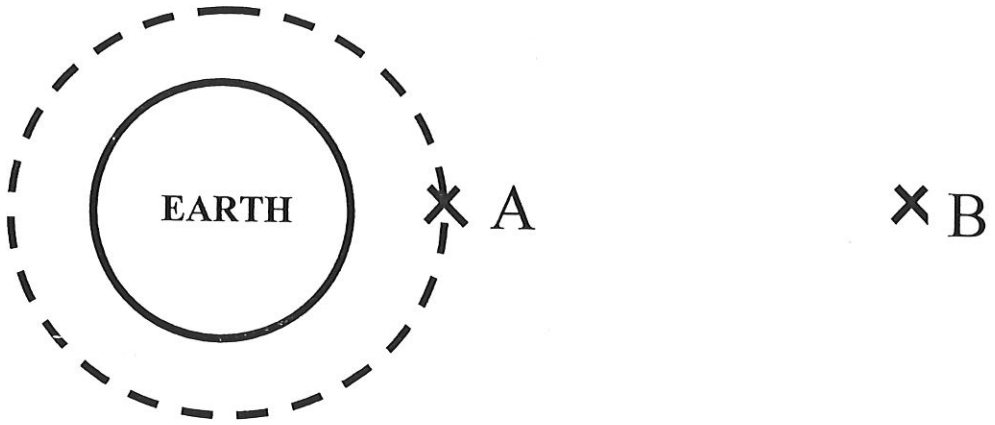
   ii. S stays at a constant height during rotation at constant speed. Write a second equation expressing the vertical equilibrium of S.

   iii. Hence, using the two equations from i and ii, calculate the value of θ.

c. The speed of the ride is suddenly increased. Describe the subsequent motion of S.

Gravitational Field
Additional Question 1
This question is about gravitational potential and the motion of a spacecraft near the Earth.

a) State the value of the gravitational potential at an infinite distance from the Earth.



b) The value of the gravitational potential at the Earth's surface, 6400 km from the centre, is -63 $MJkg^{-1}$. Above its surface, the gravitational potential of the Earth is inversely proportional to the distance from its centre.

i) Use these facts to show that the gravitational potential at A, 3600 km above the surface, is -40 $MJkg^{-1}$. See the diagram.

ii) Find the gravitational potential at B, 13600 km above the surface.

iii) A spacecraft of mass 40000 kg falls freely towards the Earth from B to A. Find the change in its potential energy, and hence the increase in its kinetic energy.

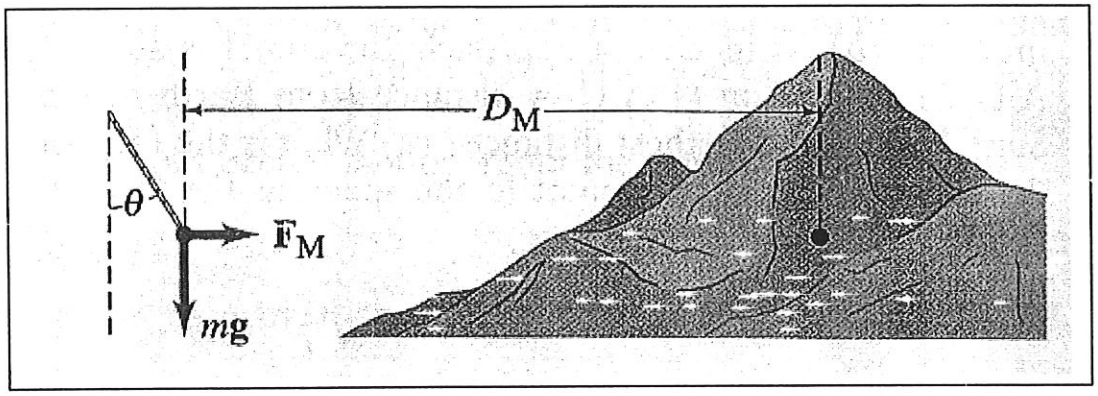
c) The spacecraft uses its motors to correct its speed and trajectory so that it moves in a circular orbit around the Earth at a height of 3600 km above the surface. The motors are switched off. The speed of the craft is 6.3 kms^{-1}. Find its total energy in this orbit.

Additional Question 2
The Sun rotates about the centre of the Milky Way Galaxy at a distance of about 30000 light years from the centre. (1 light year = 9.5×10^{15}m). If it takes about 200 million years to make one rotation, estimate the mass of our galaxy. Assume that the mass distribution of our galaxy is concentrated mostly in a central uniform sphere. If all the stars had about the mass of our Sun (2×10^{30}kg), how many stars would there be in our galaxy?

Additional Question 3

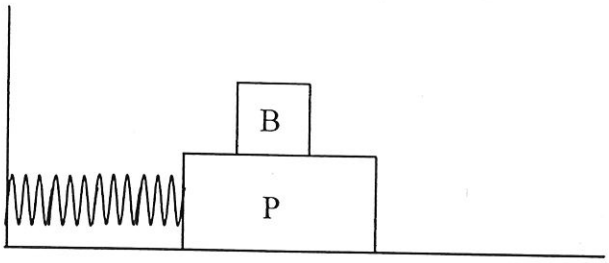
A plumb bob is deflected from the vertical by an angle θdue to a massive mountain nearby. (See fig below).

a) Find an approximate formula for θ in terms of the mass of the mountain, M_M, the distance to its centre D_M and the radius and mass of the Earth.
b) Make a rough estimate of the mass of Mt. Everest, assuming it has the shape of an equilateral pyramid 4000m high above its base.
c) Estimate the angle θ of the pendulum bob if it is 5km from the centre of Mt. Everest.



Oscillation
Additional Question 1

A large block P executes horizontal simple harmonic motion by sliding across a frictionless surface with a frequency $f = 15$ Hz. Block B rests on it, as shown in figure. The frictional force between the two bodies is given by $fr = 0.6N$, where N is the normal contact force on body B by body P. What is the maximum amplitude of oscillation can the system have if the block is not to slip?



Ideal Gas
Additional Question 1

Helium gas is contained in a cylinder by a gas-tight piston which can be assumed to move without friction. The gas occupies a volume of 1.0×10^{-3} m^3 at a temperature of 300 K and a pressure of 1.0×10^5 Pa.

(a) Calculate
  (i) the number of helium atoms in the container,
  (ii) the total kinetic energy of the helium atoms.

(b) Energy is now supplied to the gas in such a way that the gas expands and the temperature remains constant at 300 K. State and explain what changes, if any, will have occurred in the following quantities:
  (i) the internal energy of the gas,
  (ii) the r.m.s of the helium atoms,
  (iii) the density of the gas.