TEMPERATURE

1. Zeroth Law and the concept of thermal equilibrium.

   (a) Thermal equilibrium ⇔ same temperature ⇔ no net transfer of heat when in thermal contact.

   (b) TYS Questions: 2, 4, 12

2. Empirical temperature scale:

   (a) Variation of thermometric property with temperature is assumed to be linear.

   (1) For any thermometer: $R = a\theta + b$ (a, b are unknown)

   (2) For thermocouple: $E = a\Delta\theta$ $\Delta\theta = \theta(\text{hot}) - \theta(\text{cold})$

   (b) 2 fixed points are needed to determine the unknowns a & b. Alternatively can use ratio:

$$\frac{R_\theta - R_L}{\theta - \theta_L} = \frac{R_U - R_L}{\theta_U - \theta_L}$$

   (c) For centigrade scale, unless otherwise stated, the 2 fixed points are ice (0°C) & steam pt (100°C).

   (d) TYS Questions: 5, 8, 20,

3. Ideal gas temperature scale:

   (a) Variation of pressure of a fixed mass of ideal gas at constant volume is known to be linear (hence no need for linear assumption)

   $P = aT$ (a = unknown constant, T in K)
   or $PV = aT$ (if volume is not constant)

   (b) Fixed points: (0 K, 0 Pa) and (273.16 K, P_{tr})

   (c) The point (273.16 K, P_{tr}) is used to determine the unknown a. Alternatively, can use ratio:

$$\frac{P_T}{P_{tr}} = \frac{T}{273.16} \quad \text{or} \quad \frac{(PV)_T}{(PV)_{tr}} = \frac{T}{273.16}$$

   (d) Behaviour of real gases approaches ideal only at low pressure. If real gas is used, need to extrapolate $P_{tr} = 0$.

4. Thermodynamic temperature scale or absolute scale:

   - Theoretical scale
   - Consistent with the ideal gas scale.
   - Based on a fully reversible heat engine.

5. TYS Questions: 3, 6, 9, 10, 13, 16, 19

6. Conversion between Kelvin and °C:

   (a) θ K = 273.15 + θ °C

   (b) TYS Questions: 15, 17, 24

7. Main characteristics of different thermometers (refer to table at the back of temperature lecture notes)

(a) TYS Questions: 1, 14, 18, 21, 22, 23, 25, 28

KINEMATICS

1. Motion with constant speed (acceleration = 0)

s = ut

2. Motion under constant acceleration

a. v = u + at
$v^2 = u^2 + 2as$
s = ut + ½ at^2

b. Define your positive reference.

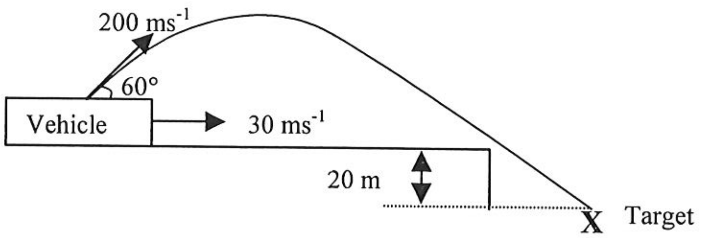
3. Projectile Motion:

Horizontal motion: Constant speed

Vertical motion: Constant acceleration

Remember to define your positive reference.

4. **Revision Exercise**. An armoured vehicle, travelling at a speed of 30 ms^{-1} (along a flat horizontal ground) fired an artillery shell, which hits a target some distance away. The shell was fired with a velocity of 200 ms^{-1} and at an angle of 60° relative to the horizontal (as shown in the diagram below). The target was at 20 m below ground level. Ignore the height of the vehicle.



(a) Calculate the time of flight of the artillery shell. [35.4 s]

(b) At what velocity will the artillery shell hit the target? [217.5 ms^{-1}, 53.3° clockwise from horizontal]

NEWTON'S LAWS (DYNAMICS)

1. Draw free body diagram of the object. Do not forget the following forces:

- **Weight** (always present)
- **Tension** (if object is tied to a string)
- **Normal contact forces** (if object is in contact with 3 different other objects / surfaces, there will be 3 normal contact forces)
- **Friction** (unless Question says ignore it)

2. Resolve all forces in 2 perpendicular directions & determine whether there is a net force in either direction.

3. If there is a net force, then there must be acceleration in the direction of the net force & vice versa.

4. Newton's 1st & 2nd Law TYS Questions: 3, 5, 11, 14, 16, 18, 23, 25, 26, 27, 29, 30.

5. Newton's 3rd Law TYS Questions: 6, 12, 22, 24, 32.

6. Newton's 2nd & 3rd Law combined: TYS Questions:17, 20, 31.

7. Concept of "Weightlessness" as **no contact forces** acting on the human body. TYS Questions 7.

LINEAR MOMENTUM

1. Force imparted by fluid: $F = (v_f - v_i)\dfrac{dm}{dt}$

 (a) Please assign positive reference direction

 (b) If density and cross sectional area are given, then $\dfrac{dm}{dt} = \rho A v$ and force on fluid = $\rho A v^2$

2. Momentum – Impulse Th'm: $P_f - P_i = \int_{t_1}^{t_2} F dt$

 (a) $\int_{t_1}^{t_2} F dt \Rightarrow$ area under the F-t graph from t_1 to t_2.

 (b) $\int_{t_1}^{t_2} F dt = F(t_2 - t_1)$ if F is constant.

 (c) Please assign positive reference direction.

3. **Revision Exercise**. An object of mass 3 kg is moving to the left at a constant speed of 2 ms^{-1}. At t = 0, a resistive force acts on it whose magnitude varies according to the graph below.

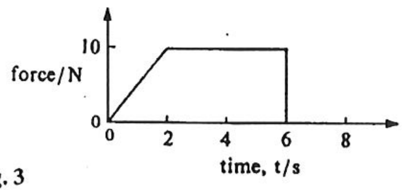


Fig. 3

What is the velocity of the mass at t = 8 seconds? [44/3 ms^{-1} moving to the right]

4. Other TYS Questions: under Dynamics topic pg 40: Questions 2, 10, 15, 21.

5. Elastic Collisions ⇒ total k.e. is conserved. To analyze elastic collisions, use

a. Principle of conservation of momentum

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Please assign positive reference direction

b. Relative speed.

$u_1 - u_2 = v_2 - v_1$

Note the switch over of subscripts

Please assign positive reference direction

6. **Revision Exercise**. The following diagram shows a hydrogen molecule of mass 2.00u colliding head-on with an oxygen molecule of mass 32u.

Given that the collision is elastic,

(a) What is the relative speed of separation of the two molecules? [2285 ms^{-1}]

(b) What is the velocity of the oxygen molecule after collision? [136 ms^{-1} moving left]

7. To analyze inelastic collisions, use

a. Principle of conservation of momentum.

b. To determine whether collision is elastic or inelastic:

(1) Compute total k.e. before and after collision and see if they are equal OR

(2) Look at the relative speed before and after collision and see if they are equal

8. **Revision Exercise**. TYS *Conservation of Linear Momentum pg 51 Question 76 (N99/II/1)*

FORCES

1. Draw free body diagram.

2. Hooke's Law for elastic strings or springs.

a. $F = kx$ (k is the spring constant and x is extension)

b. Elastic potential energy stored in spring, $E = \frac{1}{2} kx^2$ or Area under the force-extension graph.

3. **Revision Exercise**. TYS pg 57 Questions 4, 8, 9.

4. Upthrust (refer to physics of fluids)

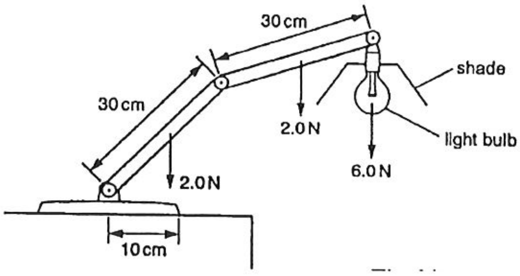
5. Static equilibrium (rotational + translational equilibrium):

a. Use principle of moments for rotational equilibrium.

b. For translational equilibrium: $\sum F_x = 0$ and $\sum F_y = 0$

6. **Revision Exercises.**

(1) A desk lamp is illustrated in the figure below.



The lamp must be constructed so that it does not topple over when fully extended as shown below. The base of the lamp is circular and has a radius of **10 cm**. The total weight of the light bulb and shade is **6.0 N** and each of the two uniform arms has weight **2.0 N**. The lamp will rotate about a point **P** if the base is not heavy enough.

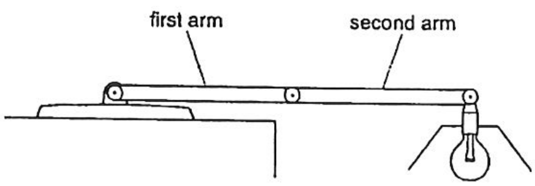
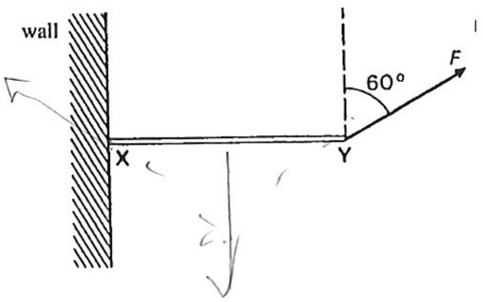


Fig. 32

Calculate the minimum weight of the base required to prevent toppling. [38 N]

(2) A uniform rod **XY** of weight **10.0 N** is freely hinged to a wall at **X**. It is held horizontal by a force ***F*** acting from **Y** at an angle of **60°** to the vertical as shown in the diagram below.



(a) What is the value of *F*? [10 N]

(b) Calculate the force exerted by the wall on the rod at **X**. [10 N, 60° anticlockwise from vert.]

WORK, ENERGY AND POWER

1. Work done by force F = Force x distance in the direction of the force.

2. Net work done by all forces = change in kinetic energy of the object.

3. Mechanical energy, m.e. = k.e. + p.e.

4. In the absence of resistive forces, Δm.e. = 0

5. In the presence of resistive forces, Δm.e. = work done against resistive force(s).

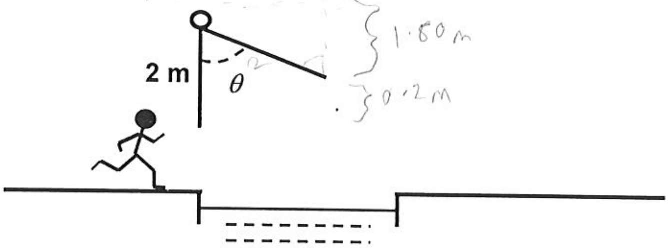
6. Power, P.

$$P = \frac{\Delta E}{\Delta t} \quad \text{or } P = \frac{\Delta W}{\Delta t} \quad \text{or } P = F.v$$

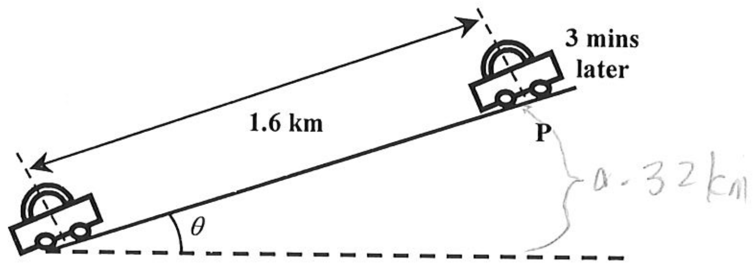
7. $$Efficiency = \frac{Useful \quad Power \quad or \quad Energy \quad Output}{Total \quad Input}$$

8. **Revision Exercise**.

(1) In the process of crossing an obstacle course, a 65-kg student running at 5.0 ms^{-1} grabs a hanging rope of length 2.0 m, and swings out over a pit of water. He releases the rope when his speed is 2.0 ms^{-1}. What is the angle θ when he releases the rope? [62°]



(2) A car of mass 1200 kg starts from rest at the foot of a hill inclined at an angle θ to the horizontal, where $\sin\theta = \frac{1}{5}$.



3.0 minutes later, the car has a speed of 20.0 ms^{-1} and has travelled a distance of 1.6 km (see diagram above) to reach **P**. The frictional forces resisting the motion are constant and of magnitude 210 N.

Calculate, in this time,

(i) the increase of potential energy of the car; [3.77 MJ]

(ii) the increase of kinetic energy of the car; [0.24 MJ]

(iii) the work done against frictional forces; and [0.336 MJ]

(iv) the average power of the engine of the car. [24.1 kW]

CIRCULAR MOTION

1. Important equations: $v = r\omega$ $a = v^2/r$ $T = 2\pi/\omega$ $f = 1/T$

2. For motion in a horizontal circle, use the following steps to solve problem:

   a. Identify all forces acting on the object (there are usually 2, sometimes 3 different forces namely weight, normal contact force, tension or lift).

   b. Resolve forces vertically & horizontally.

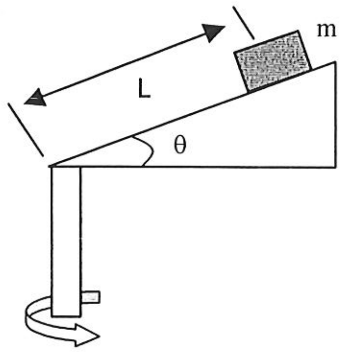
   c. In the horizontal direction, use Newton's 2nd Law:

   $F_R = \dfrac{mv^2}{r}$ where F_R represents the resultant or net force in the horizontal direction.

   d. In the vertical direction, use condition for vertical equilibrium i.e. $\sum F_y = 0$

   e. Solve simultaneous equations.

3. **Revision Exercise**. A child's toy consists of a small wedge that has an acute angle θ (see figure below). The sloping side of the wedge is frictionless, and the wedge is spun at constant speed by rotating a rod that is firmly attached to it at one end. Show that, when the mass m rises up the wedge a distance L, the speed of the mass is $v = \sqrt{gL\sin\theta}$.



4. For motion in a vertical circle:

   a. Identify all forces acting on the object.

   b. Resolve forces into radial & tangential components

   c. For radial component, use Newton's 2nd Law: Net Radial Component = $\dfrac{mv^2}{r}$

   d. If question ask about max / min / critical velocity or finding forces use Newton's 2nd law.

   e. If you are just finding speed, use conservation of energy.

5. **Revision Exercise**. TYS Question 32.

GRAVITATION

1. **Key Formulae**

	General Equations	Near Earth's Surface
Force between 2 point masses	$F = \frac{GMm}{r^2}$	$F = mg$
Gravitational Field Strength at a distance r from the centre of source M.	$g = \frac{GM}{r^2}$	$g = 9.81\ Nkg^{-1}$
Gravitational P.E. of m at a distance r from the centre of source M.	$U = -\frac{GMm}{r}$	$U = mgh$
Gravitational Potential at a distance r from the centre of source M	$\phi = -\frac{GM}{r}$	$\phi = gh$

2. Question can be asking about:

   a. Force or Field Strength - Use the appropriate formula

   b. Energy or Potential - Use the appropriate formula & / or Conservation of energy

   c. Circular Orbits

   - Use $\frac{GMm}{r^2} = \frac{mv^2}{r}$ if finding orbital speed or kinetic energy.

   - Use $\frac{GMm}{r^2} = mr\omega^2$ if finding orbital period or proving Kepler's 3rd law.

3. Helpful relation: $GM_e = gR_e^2$ if mass of the Earth is not given in the question.

4. **Revision Exercise**. A satellite P, of mass 2400 kg is placed in orbit at a distance of 4.2×10^7 m from the centre of the Earth. (Radius of the Earth = 6.4×10^6 m and acceleration due to gravity = $9.81\ ms^{-1}$)

(a) Calculate

(i) The gravitational field strength at any point along the orbital path. [$0.228\ Nkg^{-1}$]

(ii) The resultant force acting on the orbiting satellite. [547 N]

(iii) The kinetic energy of the satellite. [1.15×10^{10} J]

(iv) The total energy of the satellite. [-1.15×10^{10} J]

(v) The orbital period. [23.7 hrs]

(b) The satellite is now moved to a lower orbit of radius 2.1×10^7 m. Calculate the following quantities and state whether it is an increase or decrease.

(i) The kinetic energy of the satellite. [2.3×10^{10} J, increase]

(ii) The potential energy of the satellite. [-4.6×10^{10} J, decrease]

(iii) The total energy of the satellite. [-2.3×10^{10} J, decrease]

(c) What is the difference in gravitational potential between the two orbits? [$-9.6\ MJ\ kg^{-1}$]

OSCILLATIONS

1. Definition of Simple Harmonic Motion: $a = -\omega^2 x$

2. Displacement, velocity, acceleration, k.e. and p.e. in terms of time:

	At $t = 0$, $x = x_0$	At $t = 0$, $x = -x_0$	At $t = 0$, $x = 0$ $v = +\omega x_0$ *(particle is moving upwards)*	At $t = 0$, $x = 0$ $v = -\omega x_0$ *(particle is moving downwards)*
Displacement (x)	$x = x_0 \cos \varpi t$	$x = -x_0 \cos \varpi t$	$x = x_0 \sin \varpi t$	$x = -x_0 \sin \varpi t$
Velocity, $v = \dfrac{dx}{dt}$	$v = -\omega x_0 \sin \omega t$	$v = \omega x_0 \sin \omega t$	$v = \omega x_0 \cos \omega t$	$v = -\omega x_0 \cos \omega t$
Acceleration, $a = \dfrac{dv}{dt}$	$a = -\omega^2 x_0 \cos \omega t$	$a = \omega^2 x_0 \cos \omega t$	$a = -\omega^2 x_0 \sin \omega t$	$a = \omega^2 x_0 \sin \omega t$
Kinetic Energy, $= \dfrac{1}{2} m v^2$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \sin^2 \omega t$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \sin^2 \omega t$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \cos^2 \omega t$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \cos^2 \omega t$
Potential Energy, $= \dfrac{1}{2} m\omega^2 x^2$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \cos^2 \omega t$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \cos^2 \omega t$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \sin^2 \omega t$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2} \sin^2 \omega t$
Total Energy	$\dfrac{1}{2} m\omega^2 x_0^{\ 2}$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2}$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2}$	$\dfrac{1}{2} m\omega^2 x_0^{\ 2}$

3. Velocity, acceleration, k.e. and p.e. in terms of displacement (x)

Velocity	$v = \pm\omega\sqrt{x_0^{\ 2} - x^2}$
Acceleration, $a = \dfrac{dv}{dt}$	$a = -\omega^2 x$
Kinetic Energy, $= \dfrac{1}{2} m v^2$	$\dfrac{1}{2} m\omega^2 \left(x_0^{\ 2} - x^2\right)$
Potential Energy	$\dfrac{1}{2} m\omega^2 x^2$

4. Be able to sketch the graphs of all the above equations.

5. Damped oscillations (oscillator under the influence of resistive force, total energy of the oscillator decreases with time due to work done against resistive force). Remember the following graphs:

   (a) Graph of total energy versus time or graph of total energy versus number of oscillations.
   (b) Graph of amplitude versus time or graph of amplitude versus number of oscillations.
   (c) Graph of displacement versus time for light damping.
   (d) Graph of displacement versus time for critical damping.
   (e) Graph of displacement versus time for heavy damping.

6. Damping results in two effects:

   (a) Amplitude (or total energy) of the oscillator decreases exponentially with time.
   (b) Period of the oscillator is slightly longer than in the absence of resistive force.

7. Forced oscillation (oscillator under the influence of external periodic force of frequency f_d. Energy from the external force is transferred to the oscillator).

8. Resonance – if f_d equals the natural frequency of the oscillator, resonance occurs and maximum energy is transferred from the external force to the oscillator. The amplitude of the oscillator reaches a maximum.

9. Important graph to remember: Graph of amplitude versus driver frequency, f_d.

10. **Revision Exercise**. A 0.20 kg mass, **P**, suspended at one end of a light vertical spring is pulled downwards by 5.0 cm and released. The spring constant is 10 Nm^{-1}. The frequency of oscillation can be obtained from the equation $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$.

(a) Using separate axes, sketch the following graphs.

(1) Displacement of **P** with respect to time.

(2) Velocity of **P** with respect to time.

(3) Kinetic energy of **P** with respect to time.

(4) Kinetic energy of **P** with respect to displacement.

(b) Write down the following equations

(1) Displacement of **P** with respect to time. [$x = -0.05\cos\left(t\sqrt{50}\right)$]

(2) Kinetic energy of **P** with respect to time. [$k.e. = 0.0125\sin^2\left(t\sqrt{50}\right)$]

(3) Kinetic energy of **P** with respect to displacement. [$k.e. = 0.0125 - 5x^2$]

(c) What is the total energy of **P**? [0.0125 J]

(d) On **graph (a)(1)**, sketch how the displacement of **P** will vary with time if the oscillation is subjected to light damping.

(e) If the oscillator is coupled to an external periodic force of variable frequency, sketch how would the amplitude of the resulting oscillation varies with the frequency of the external force.

PHYSICS OF FLUIDS

1. Upthrust

a. Upthrust, U = $\rho_f V_s g$

b. Weight, W = $\rho_o V_o g$

c. If object floats $\Rightarrow$ W = U

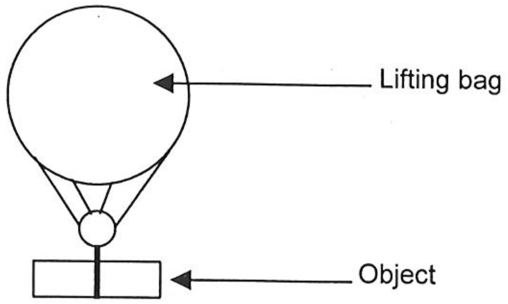
d. If object sinks $\Rightarrow$ W > U

2. **Revision Exercises**.

(1) Given that the density of seawater is 1030 kgm^{-3}, the submarine has a volume of 250m^3 and mass 25000 kg, using the Principle of Flotation, find the proportion of the submarine that is under the sea. [9.71%]

(2) A party is in progress in a small swimming pool. All the guests climbed into a large rubber boat, and are having an argument about Archimedes' Principle. Jack claims that if all leave the boat, and float in the pool instead, the water level will rise. On the other hand, Rose says that the water level will fall. What do you think will happen to the water level? Explain your answer. [No change]

(3) In order to raise an object from the seabed, a 'lifting bag' may be attached to the object and then partially inflating it with air, as shown in the diagram. For this question, assume that the lifting bag is made of inelastic material.



(a) A submerged object of mass 800 kg and density 5000 kgm^{-3} is attached to a lifting bag of negligible volume and mass. Estimate the initial acceleration of the object when $0.700m^3$ of air is suddenly released into the bag. ($\rho_{sea\ water}$ = 1050 kgm^{-3}) [1.26 ms^{-2}]

(b) If the same volume of helium gas is used instead of air, calculate the following:

(i) Upthrust [8858 N]

(ii) Initial acceleration [1.26 ms^{-2}]

3. Metacentre and Stability

a. Locate centre of buoyancy & CG

b. Locate metacentre

c. Ship is stable if torque due to U & W has a restoring effect.

4. Non Viscous Flow

a. Volume Flow Rate $\dfrac{dV}{dt} = Av$

b. Mass Flow Rate $\dfrac{dM}{dt} = \rho Av$

c. Deriving & applying Continuity Equation

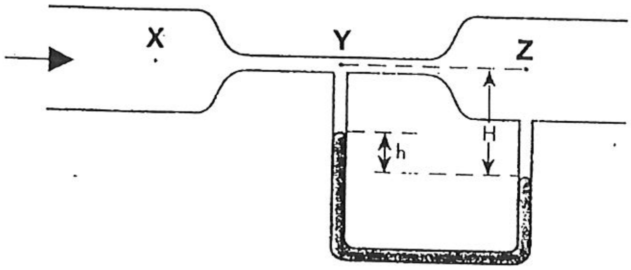
d. Deriving & applying Bernoulli's Equation

e. Using Bernoulli Effect to explain lift on

(1) Aerofoil
(2) Filter Pump
(3) Atomiser
(4) Venturi Meter
(5) Golf / Soccer / Cricket balls

5. **Revision Exercise**.

In the figure below, a horizontal pipe has a cross-sectional area of 5.0×10^{-4} m^2 at Y and 30×10^{-4} m^2 at Z. A powerful pump at X pumps water, which flows smoothly along the pipe. The water leaves the pipe at Z with a velocity of 2.0 ms^{-1}. (ρ_w = 1000 kgm^{-3} and ρ_{Hg} = 13,600 kgm^{-3}).



(i) Determine the velocity of water at Y. [12 ms^{-1}]

(ii) Calculate the pressure difference between Y and Z. [70 kPa]

(iii) Hence, find the difference in level h of the mercury columns in the manometer.

$$h = \frac{P_z - P_y}{(\rho_{Hg} - \rho_w)g}$$ [0.566 m]

6. Viscous Force

a. Stoke's law for a sphere under steady condition: $F = 6\pi\eta a v$

b. Under turbulent conditions $F \propto v^2$

c. Deriving Terminal Velocity by Equating Forces

d. Reynold numbers

(1) Know what the symbols represent
(2) Turbulent flow if $R_e > 2000$

WAVES

1. Wave Speed $v = f\lambda$

2. Particle Motion – Simple Harmonic Motion

3. Phase difference:

(a) $\Delta\phi = \frac{\Delta x}{\lambda} \times 2\pi$ (spatial separation)

(b) $\Delta\phi = \frac{\Delta t}{T} \times 2\pi$ (temporal separation)

4. Energy carried by a wave: $E \propto f^2 Ampl^2$

5. Intensity = $\dfrac{Power}{Area} = \dfrac{Energy}{time \times Area}$

6. For Point Sources (or Spherical Waves): Area = $4\pi r^2$; Intensity $\propto 1/r^2$

7. For plane waves, Intensity = Constant

8. Go through the 4 worksheets.

9. EM Spectrum TYS MCQ (pg 159: Questions 54 to 70)

SUPERPOSITION

1. **Stationary Wave**

   a. Sketch the pattern depending on the model, i.e.

      (i) string with both end fixed.
      (ii) Pipe with one end closed.
      (iii) Pipe with both end open.

   b. Relate the length of the pipe / string to the wavelength of the stationary wave to determine frequency of 1st, 2nd, 3rd or higher order harmonics.

   c. N-N separation or A-A separation = $\lambda/2$

   e. A-N separation = $\lambda/4$

2. **Study the tutorial questions (tutorial A).**

3. **Single slit diffraction**: We are interested in the angular position of the first minima.

   a. path difference = $\dfrac{a}{2}\sin\theta$ where a = width of the slit. $x = \frac{\lambda D}{a}$

   b. angular position of first minima: $\dfrac{a}{2}\sin\theta = \dfrac{\lambda}{2}$

   c. Width of central bright spot: = 2θ (this gives the amount of "spreading" or diffraction).

4. **Double Slit Interference Pattern**. We are interested in the angular positions of both the bright & dark fringes.

   a. Path difference = b $\sin\theta$ where b represents the spacing between slits.

   b. If $\Delta\phi_s = 0$, i.e. the sources are in phase, bright fringes will appear at angular positions given by b $\sin\theta = n\lambda$ for the nth bright fringe relative to the centre. Bright fringes $\Rightarrow$ constructive interference $\Rightarrow$ phase difference between the two waves from the 2 sources = $2n\pi$ (or even multiples of π)

   c. If $\Delta\phi_s = 0$, dark fringes will appear at angular positions given by b $\sin\theta = (n - \frac{1}{2})\lambda$ for the nth dark fringe relative to the centre. Dark fringe $\Rightarrow$ destructive interference $\Rightarrow$ phase difference between the two waves from the 2 sources = $(2n + 1)\pi$ (or odd multiples of π)

   d. B-B separation along the screen = $\dfrac{\lambda D}{b}$

5. **Study the tutorial questions (Tutorial B)**

6. **Diffraction Grating**. We are interested in finding the angular positions of the maximas.

   a. path difference = d sinθ where d represents the spacing between adjacent slits.

   b. for a grating with n lines per cm, d = (1/x) cm

   c. to find angular position of nth maxima relative to the centre, use d sinθ = nλ

7. **Study the tutorial questions (Tutorial C)**

IDEAL GAS

1. Three important formulae:

   a. $PV = nRT$ n = no. of moles

   b. $PV = NkT$ N = no. of molecules

   c. $P = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$ m = mass of 1 molecule

2. Relation between k & R: $k = \frac{R}{N_A}$

3. Ave. k.e. of 1 molecule: $= \frac{3}{2}kT$

4. Internal Energy of Monatomic Ideal gas $U = \frac{3}{2}nRT$

5. Root-mean-square speed of 1 molecule c_{rms}: $c_{rms} = \sqrt{\frac{3kT}{m}}$ or $c_{rms} = \sqrt{\frac{3RT}{M_r}}$.

6. Basic assumptions of the kinetic theory of gases.

7. Go through the examples in the lecture notes.

THERMAL PROPERTIES

1. Working with specific heat capacities and specific latent heat: **Heat Loss = Heat Gain**

2. Refer to examples: 3, 4, 5 & 6 in lecture notes.

3. Working First Law of Thermodynamics: $q + w = \Delta U$

4. Refer to examples: 8, 9, 10, 11, 12

5. Know the characteristics of the 5 processes (isochoric, isobaric, isothermal, adiabatic & cyclic)