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Faculty	:	Agriculture, Engineering and Natural Science	
Department	:	Physics, Chemistry & Material Science	
Subject	:	Physics Support (I)	
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FIRST OPPORTUNITY EXAMINATION

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This question paper consists of **5** pages of questions excluding this front page.

INSTRUCTIONS:

- Answer ***all*** the questions.
- Calculators may be used.
- Please answer only in the provided examination answer book.
- Clearly and completely provide your surname and student number on all answer books used.
- Some universal constants are provided on the last page of this question paper.
- Demonstrate understanding by showing all your work, including diagrams.

UNIVERSITY OF NAMIBIA EXAMINATIONS

Question 1 ..... Total: 18

(a) What is the SI unit for the following base quantities: [4]

1. Mass
2. Luminosity
3. Time
4. Temperature

(b) Choose from the list below to differentiate two ways by which fluids flow. [recreate the table] [8]

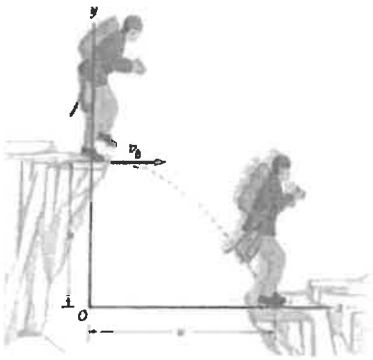
1. Characterized by high velocities
2. Fluid travel smoothly/in regular paths/parallel layers
3. Paths do not mix/cross
4. Fluctuations in magnitude and direction of velocity of fluid particles
5. Velocity of each fluid particle passing remains constant with time
6. Irregular/random movement of particles
7. Characterized by lower velocities
8. Different streamlines cross and mix

Streamline flow	**Turbulent flow**

(c) What is the difference between specific latent heat and specific heat capacity. [6]

Question 2 ..... Total: 6

In the figure below, a mountain climber needs to clear gap, W = 12 m from a height h = 2.75 m in order to prevent falling into a deep crevasse.



(a) If he takes off horizontally at 14 m/s, will he make it? [3]

(b) What is the lowest angle required to jump off the cliff at, if his jumping speed is increased to 18 m/s? [3]

Question 3 ..... Total: 18

(a) Define the principle of moments. [2]

(b) When three forces of different magnitudes and directions act on the same object simultaneously, how will you know if these forces cause the object to be stationary? [1]

(c) Determine the vertical component for the force 4 N acting at 230°. [2]

(d) Determine the reference angle to the vertical for the velocity 22 m/s at 251°. [2]

(e) Two students push a table. One pushes 18 N East, the other 11 N West. Find the net force and direction. [2]

(f) A 9 kg crate was pushed with 100 N on a floor with friction. It starts from rest and reaches 5 m/s in 10 s. Calculate the Friction force experienced by the crate. [4]

(g) Construct the free body diagram using correct symbols: A uniform beam is pivoted at 4 m from the left end. Loads are placed as follow: 4 N at 8 m from the pivot, 16.75 N at the left end and 10 N in the middle of the 15 m long beam. The weight of the beam is 50 N. [5]

Question 4 ..... Total: 12

(a) A basketball coach insists that his players be at least 180 cm tall. Would a layer of height 5 ft 12 inch tall qualify to be part of the team? [3]

(b) A horizontal force of 310 N is exerted on a 2.0 kg ball as it rotates (at arm's length) uniformly in a horizontal circle of radius 0.90 m. Calculate the speed of the ball. [3]

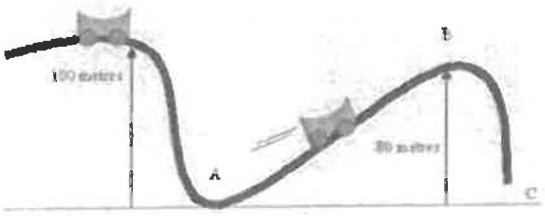
(c) State any one of Keplers laws for planets. [1]

(d) If two particles are separated by a distance of 2.00×10^{-4} m. What is the gravitational force exerted on the first particle by the second particle if $m_1 = 6.00 \times 10^{-31}$ kg and $m_2 = 4.00 \times 10^{-31}$ kg. [2]

(e) A Formula 1 car races around a sharp curve at a constant speed of 320km/h, then it travels around a gentle curve at the same speed. Will its acceleration be the same?[Hint: give a formula to support your answers] [3]

Question 5 ..... Total: 8

At the starting point of h = 100 m, the 2 kg toy car in the figure below is moving at 1.5 m/s.



(a) At point A where h = 0 m and the toy car is moving at 42 m/s, how much energy was converted to heat due to friction? [4]

(b) From A to B the surface is frictionless. Determine the velocity at point B. [4]

Question 6 ..... Total: 5

A person uses a trolley to move suitcases at an airport. The total mass of the trolley and suitcases is 72 kg. When the trolley is released at a constant speed of $1.4\,\mathrm{m\,s^{-1}}$ it experiences a resistive force of 18 N. Calculate

(a) the power required to overcome the total resistive force on the trolley and suitcases. [2]

(b) the time taken for the trolley to come to rest after it is released. [3]

Question 7 ..... Total: 3

(a) Give a mathematical expression of momentum. [1]

(b) Starting with Newton's second law ($F = ma$), show that $Impulse(I) = F\Delta t = \Delta p$. [2]

Question 8 ..... Total: 9

A vulture's eye can distinguish a prey at and angle less than about 3×10^{-4} rad.

(a) How many degrees is this? [2]

(b) How small an object/prey can the vulture distinguish when flying at a height of 100 m? [4]

(c) What is the angular momentum of a 0.270 kg ball revolving on the end of a thin string in a circle of radius 1.35 m at an angular speed of 10.4 rad s^{-1}? [Hint: $I = MR^2$] [3]

Question 9 ..... Total: 5

(a) A body weighs 5.5 N in air and 3 N when completely immersed in kerosene, what is the upthrust experienced by the object? [2]

(b) It takes 2 hours to fill a swimming pool with dimensions 6 m x 4 m x 2 m. Determine the flow rate. [2]

(c) Convert the volumetric flow rate in (b) to mass flow rate, if water was used. [1]

Question 10 ..... Total: 10

A 0.650 kg mass oscillates according to the equation $x = 0.25 \sin 4.70t$ where x is in meters and t is in seconds. Determine

(a) the amplitude. [1]

(b) the frequency. [2]

(c) the period. [2]

(d) A stationary ambulance emits a siren tone with a frequency of 750 Hz. A cyclist rides directly toward the ambulance and then passing it, causing the cyclist to hear a frequency 12 Hz different from the actual siren frequency. If the speed of sound in air is 340 m/s, what is the speed of the cyclist? [5]

Question 11 ..... Total: 6

(a) If the temperature is 15 °C below zero on the Celsius scale, what is the reading on the Fahrenheit scale? [2]

(b) 4 kg of alcohol is in a closed container. The alcohol is at room temperature ($23°C$). How much heat energy would be required to boil half of the mass of alcohol. Alcohol boils at $78°C$. [$c = 2.4$ kJ/kg°C; $L_v = 8.6 \times 10^5$ J/kg; $L_f = 109$ kJ/kg] [4]

Full marks: 100

Some useful constants:

Gravitational constant:	$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2kg^{-2}}$
Gravitational acceleration:	$\mathrm{g} = 9.81\ \mathrm{m\,s^{-2}}$
Mass of the Earth:	$M_E = 5.97 \times 10^{24}\ \mathrm{kg}$
Radius of the Earth:	$r_E = 6.38 \times 10^{6}\ \mathrm{m}$
Mass of a proton:	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
Speed of sound:	$v_{sound} = 343\ \mathrm{m\,s^{-1}}$
Horse power:	$1\ \mathrm{hp} = 746\ \mathrm{W}$
Inches to centimetre:	$1\ \mathrm{in} = 2.54\ \mathrm{cm}$
Feet to inches:	$1\ \mathrm{ft} = 12\ \mathrm{in}$
Density of water:	$\rho_{water} = 1000\ \mathrm{kg/m^3}$

Some useful formulæ:

$v = u + at$	$\Delta x = ut + \frac{1}{2}at^2$	$v^2 = u^2 + 2a\Delta x$
$F = ma$	$F_{12} = \frac{Gm_1m_2}{r_{12}^2}$	$P = \frac{W}{t}$
$W = Fs\cos\theta$	$p = mv$	$l = r\theta$
$L = I\omega$	$P = \rho g \Delta h$	$v = f \times \lambda$
$\omega = 2\pi f$	$T = \frac{1}{f}$	$E_k = \frac{1}{2}mv^2$
$E_p = \frac{1}{2}kx^2$	$E_p = mgh$	$Q = mc\Delta T$
$f_o = \frac{fv}{(v \pm v_s)}$	$f_o = \frac{f(v \pm v_s)}{v}$	$\frac{V_{sub}}{V_o} = \frac{\rho_o}{\rho_f}$
$F_B = W_f$	$F_B = W_{true} - W_{app}$	$Q_V = \frac{V}{t} = Av$
$Q_m = \frac{m}{t} = \rho Q_V$	$A_1v_1 = A_2v_2$	$W_{nc} = \Delta E$
$\frac{1}{2}mu^2 + mgh_0 = \frac{1}{2}mv^2 + mgh$		$m_1u_1 + m_2u_2 = m_1v_2 + m_2v_2$