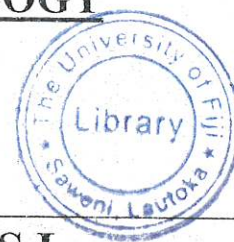




SCHOOL OF SCIENCE AND TECHNOLOGY
Semester 1, 2025

FINAL EXAMINATION PAPER



PHYF11: FOUNDATION PHYSICS I

Important Instructions to Students:

1. There are 10 pages. Read the questions, instructions carefully and answer the questions.
2. You are allowed an **extra 10 minutes reading time** (during this time, you are not allowed to write with pen) and **180 minutes (3 Hours) to complete this paper**.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask from the supervisor. Write your name, course code and student identification number in the answer booklet and in the attendance sheet.
5. This paper contains TWO (2) sections A, and B. All questions are compulsory to answer.
6. Write all your answers legibly. The marker has the right to award zero for answers that are not legible.
7. This is a **Closed Book Examination**. The University views plagiarism, cheating and dishonest practice as serious offences and if found, offenders are penalized.

Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-10	Short Answer Questions	30	65 minutes
B	1-4	Long Answer Questions	70	115 minutes
		TOTAL	100	180 Minutes

Use the following data where necessary:

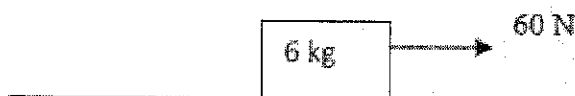
Stefan-Boltzmann constant, σ	=	$5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$
Acceleration due to gravity, g	=	9.81 ms^{-2}
Gravitational constant, G	=	$6.672 \times 10^{-11} \text{ Nm}^2 \text{ kg}^{-1}$
Electric field constant, ϵ_0	=	$8.854 \times 10^{-12} \text{ Fm}^{-1}$
Magnetic field constant, k	=	$2 \times 10^{-7} \text{ Hm}^{-1}$
Permeability of free space, μ_0	=	$4\pi \times 10^{-7} \text{ Hm}^{-1}$
Coulomb's law constant, $k = \frac{1}{4\pi\epsilon_0}$	=	$9.0 \times 10^9 \text{ Nm}^2 \text{ C}^{-2}$
Speed of light in vacuum, c	=	$2.998 \times 10^8 \text{ ms}^{-1}$
Planck's constant, h	=	$6.626 \times 10^{-34} \text{ Js}$
Electronic charge, e	=	$1.602 \times 10^{-19} \text{ C}$
Electron rest mass, m_e	=	$9.11 \times 10^{-31} \text{ kg}$
Proton rest mass, m_p	=	$1.673 \times 10^{-27} \text{ kg}$
Rydberg constant, R	=	$1.097 \times 10^7 \text{ m}^{-1}$
Mass of earth, M_e	=	$5.98 \times 10^{24} \text{ kg}$
Radius of earth, R_e	=	$6.37 \times 10^6 \text{ m}$
Speed of sound in air	=	340 ms^{-1}

Formulae

1. $V_f = V_i + at$
2. $s = V_i t + \frac{1}{2}at^2$
3. $V_f^2 = V_i^2 + 2as$
4. $E_k = \frac{1}{2}mv^2$
5. $E_p = mgh$
6. $F_g = \frac{GMm}{r^2}$
7. $\theta = \frac{d}{r}$
8. $\omega_f = \omega_i + \alpha t$
9. $\theta = \omega_i t + \frac{1}{2}\alpha t^2$
10. $\omega_f^2 = \omega_i^2 + 2\alpha\theta$
11. $\Delta L = \alpha L_0 \Delta T$
12. $T_K = T_C + 273$
13. $H = Ae\sigma T^4$
14. $Q = mc\Delta T$
15. $PV = nRT$
16. $I = F\Delta t$

There are **10 questions** in this section, all questions are compulsory. Each question is worth 3 marks.

1. The official land speed record of the ThrustSSC car is 1228.0 km/hr. Express this speed in meters/s.
2. For each of these values, identify the number of significant figures and rewrite it in standard form:
 - i. 409.8 s
 - ii. 0.058700 cm
 - iii. 9500g
3. A rectangular piece of aluminum is 5.1 ± 0.1 cm long, and 1.90 ± 0.01 cm wide. Determine the area of the rectangular sheet with appropriate uncertainty.
4. A latest BMW car is capable of reaching 100 km/h in 5.4 s if it starts from rest. What is the acceleration of the car during this period?
5. A ball is thrown directly downward with an initial speed of 8.00 m/s from a height of 30.0 m. After what time interval does it strike the ground?
6. A 6.00 kg mass is connected by a light inextensible string as shown below and is pulled over a rough surface with $\mu_s = 0.25$. Calculate:



- i. The acceleration of the system
 - ii. The tension in the string
7. A 0.0450 kg golf ball initially at rest is given a speed of 25 m/s when a club strikes. If the club and the ball are in contact for 2.00 ms, what average force acts on the ball?
8. An airplane propeller is rotating at 1900 rpm (rev/min).
 - i. Compute the propeller's angular velocity in rad/s
 - ii. How many seconds does it take for the propeller to turn 35° ?

9. A balloon has a volume of 30.0 L at 40°C and 153 kPa. What volume will the balloon have at standard temperature and pressure (STP)?
10. How much heat must be added to 0.45 kg aluminum to change it from a solid to liquid at 130°C to a liquid at 660°C (its melting point)? [The latent heat of fusion for aluminum is 4.0×10^4 J/kg]

There are 4 questions in this section. All questions are compulsory.

Question 1 [25 marks]

- a) A rocket fires two engines simultaneously. One produces a thrust of 725 N directly forward, while the other gives a 513 N thrust at 32.4° above the forward direction. Determine the magnitude and direction (relative to the forward direction) of the resultant force that these engines exert on the rocket.

[5 marks]

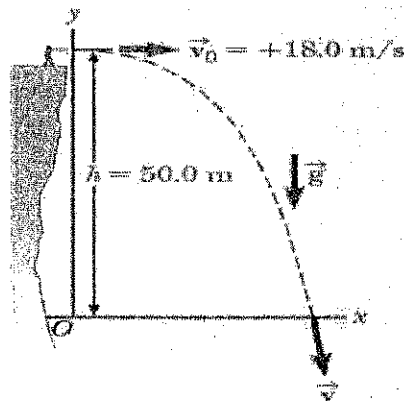
- b) A plane leaves the airport in Nadi and flies 170 km at 68° East of North and then changes direction to fly 230 km at 48° South of East, after which it makes an immediate emergency landing in a pasture. When the airport sends out a rescue crew, in which direction and how far should this crew fly to go directly to this plane?

[5 marks]

- c) The Fiji Airways aircraft needs a speed of 240 km/h to take off.
- What minimum constant acceleration is required by the aircraft to be airborne from the Nausori airport, if the runway is 300 m long?
 - How long does it take the aircraft to become airborne?

[3 + 2 marks]

- d) A student stands at the edge of a cliff and throws a stone horizontally over the edge with a speed of 18.0 m/s. The cliff is 50.0 m above a flat, horizontal beach as shown in the figure.

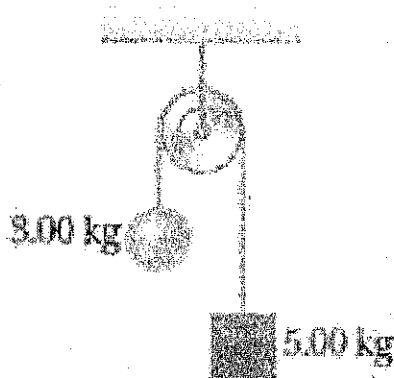


- i. What are the coordinates of the initial position of the stone?
- ii. What are the components of the initial velocity?
- iii. Write the equations for the x - and y -components of the velocity of the stone with time.
- iv. Write the equations for the position of the stone with time, using the coordinates in the figure.
- v. How long after being released does the stone strike the beach below the cliff?
- vi. With what speed and angle of impact does the stone land?

[1+1+1+2+3+2 marks]

Question 2 [10 marks]

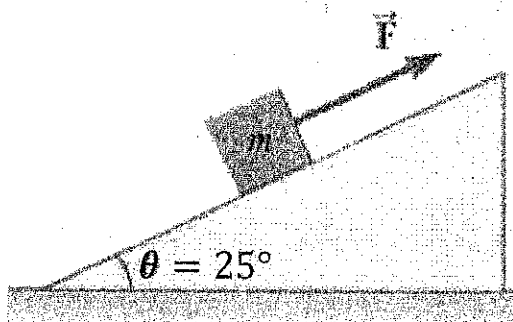
- a) Two objects with masses of 3.00 kg and 5.00 kg are connected by a light string that passes over a frictionless pulley, as in the Figure. Determine:



- The tension in the string
- The acceleration of each object
- The distance each object will move in the first second of motion if both objects start from rest.

[2+2+2 marks]

- b) A block of mass $m = 5.8$ kg is pulled up an incline as in the Figure, with a force of magnitude $F = 32$ N.



- Determine the acceleration of the block if the incline is frictionless
- Determine the acceleration of the block if the coefficient of kinetic friction between the block and incline is 0.10.

[2+2 marks]

Question 3 [18 marks]

- a) You are standing on a sheet of ice that covers the football stadium parking lot; there is negligible friction between your feet and the ice. A friend throws you a 0.400 kg ball that is travelling horizontally at a speed of 10 m/s. Assuming your mass is 70 kg,
- If you catch the ball, with what speed do you and the ball move afterward?
 - If the ball hits you and bounces off your chest, it moves horizontally at 8.0 m/s in the opposite direction, what is your speed after collision?

[2+3 marks]

- b) The blade in a blender speeds up from 24 rad/s to 74 rad/s uniformly. During this time, it turns through 40 revolutions. Calculate:
- The angle turned through in radians
 - The angular acceleration
 - The time taken to turn 40 revs

[2+2+2 marks]

- c) A grandfather clock is controlled by swinging brass pendulum that is 1.3 m long at a temperature of 20°C. [The average coefficient of Linear expansion of Brass is $19 \times 10^{-6}/^{\circ}\text{C}$]
- What is the length of the pendulum rod when the temperature drops to 0.0°C?
 - If the pendulum's period is given by $T = 2\pi \sqrt{\frac{L}{g}}$, where L is its length, does the change in length of the rod cause the clock to run fast or slow?

[2+3 marks]

- d) An engineer pumps 5.00 mol of carbon monoxide gas into a cylinder that has a capacity of 20.0 L. what is the pressure in kPa of CO inside the cylinder at 298 K?

[2 marks]

Question 4 [17 marks]

- a) If the total surface area of the human body is 1.20 m^2 and the surface temperature is 35°C ,
- Determine the total rate of radiation of energy from the body
 - If the surroundings are at a temperature of 20°C , what is the net rate of heat loss from the body by radiation? [The emissivity of the body is very close to unity, irrespective of skin pigmentation].
- [2+3 marks]
- b) Ice at 0.0°C is placed in a Styrofoam cup containing 0.32 kg of lemonade at 27°C . The specific heat capacity of lemonade is virtually the same as that of water [$4186 \text{ J/Kg } ^\circ\text{C}$]. After the ice and lemonade reach an equilibrium temperature, some ice still remains. The latent heat of fusion of water is $L_f = 3.35 \times 10^5 \text{ J/kg}$. Assume that the mass of the cup is so small that it absorbs a negligible amount of heat and ignore heat loss to the surroundings. Determine the mass of ice that has melted.
- [5 marks]
- c) State Newton's First, Second, and Third Laws of motion.
- [3 marks]
- d) Define elastic and inelastic collisions. How do they differ in terms of momentum and kinetic energy? Provide an example of each type of collision.

[4 marks]

THE END

