



The University of Fiji
(An Entity of Arya Pratinidhi Sabha of Fiji)



School of Science and Technology

Semester 1, 2026

FINAL EXAMINATION PAPER

PHYF11: FOUNDATION PHYSICS I

Important Instructions to Students:

1. There are 8 pages. Read the questions, instructions carefully and answer the questions.
2. You are allowed an **extra 10 minute 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 three (3) sections A, B, and C. 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	Multiple Choice	10	15 minutes
B	1 - 15	Short Answer Questions	30	45 minutes
C	1 - 6	Long Answer Questions	60	120 minutes
		TOTAL	100	180 Minutes

DATA

Acceleration due to gravity, g	$= 9.80 \text{ m s}^{-2}$
Atmospheric pressure	$= 1.013 \times 10^5 \text{ Pa (1 atm)}$
Avogadro number, N_A	$= 6.02 \times 10^{23} \text{ mol}^{-1}$
Boltzmann constant, k_B	$= 1.38 \times 10^{-23} \text{ J K}^{-1}$
Latent heat of fusion of water	$= 3.33 \times 10^5 \text{ J kg}^{-1}$
Latent heat of vaporization of water	$= 2.26 \times 10^6 \text{ J kg}^{-1}$
Mass of the Earth, M_E	$= 5.98 \times 10^{24} \text{ kg}$
Radius of the Earth, R_E	$= 6.38 \times 10^6 \text{ m}$
Specific heat capacity of ice, c_{ice}	$= 2090 \text{ J kg}^{-1}\text{°C}^{-1}$
Specific heat capacity of water, c_{water}	$= 4186 \text{ J kg}^{-1}\text{°C}^{-1}$
Stefan Boltzmann constant, σ	$= 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Universal gravitational constant, G	$= 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Universal gas constant, R	$= 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$

Source:

Serway, R. A. and Vuille, C., [2015]. *College Physics*, (10th Edition). CENGAGE Learning, Stamford, USA.

SECTION A**MULTIPLE CHOICE****10 MARKS**

There are 10 multiple choice questions. Choose the best answer and write in the answer booklet provided. One mark will be awarded for every correct choice. You are advised not to spend more than 15 minutes in this section. **All questions are compulsory.**

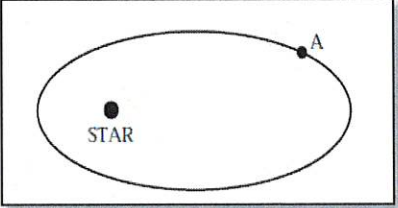
1. To jump off the floor, the floor must exert a force on you which is:
 - A. in the direction of and equal to your weight.
 - B. opposite to and equal to your weight.
 - C. in the direction of and less than your weight.
 - D. opposite to and less than your weight.
 - E. opposite to and greater than your weight.

2. A satellite circles planet Roton every 2.8 hours in an orbit having a radius of 1.2×10^7 m. If the radius of Roton is 5.0×10^6 m, what is the magnitude of the free-fall acceleration on the surface of Roton?
 - A. 31 m/s^2
 - B. 27 m/s^2
 - C. 34 m/s^2
 - D. 40 m/s^2
 - E. 19 m/s^2

3. Two eggs of equal mass are thrown at a blanket with equal velocity. Egg B hits the blanket, while egg A is misdirected and hits the wall instead. Compare the work done on the eggs in reducing their velocities to zero.
 - A. more work was done on A than on B.
 - B. more work was done on B than on A.
 - C. the amount of work is the same for both.
 - D. it is meaningless to compare the amount of work because the forces were so different.
 - E. work was done on B, but no work was done on A because the wall did not move.

4. A 2.0 kg object moving with a velocity of 5.0 m/s in the positive x direction strikes and sticks to a 3.0 kg object moving with a speed of 2.0 m/s in the same direction. How much kinetic energy is lost in this collision?
 - A. 2.4 J
 - B. 9.6 J
 - C. 5.4 J
 - D. 0.6 J
 - E. 6.0 J

5. A spring ($k = 200 \text{ N/m}$) is suspended with its upper end supported from a ceiling. With the spring hanging in its equilibrium configuration, an object (mass = 2.0 kg) is attached to the lower end and released from rest. What is the speed of the object after it has fallen 4.0 cm?
 - A. 90 cm/s
 - B. 79 cm/s
 - C. 96 cm/s
 - D. 83 cm/s
 - E. 57 cm/s

6. After a projectile has been launched from the ground, when will its velocity reach zero?
- when the projectile is released.
 - when the projectile is at the maximum height.
 - when the projectile starts to descend.
 - when the projectile is just about to hit the ground.
 - never.
7. Two objects, with masses m_1 and m_2 ($m_1 > m_2$), are travelling with different velocities (v) but have equal kinetic energy. How do their velocities compare?
- $v_1 > v_2$
 - $v_1 = v_2$
 - $v_1 < v_2$
 - Their velocities cannot be compared without knowing momentum
 - Both must have the same speed but opposite directions.
8. The figure shows a planet travelling in a clockwise direction on an elliptical path around a star located at one focus of the ellipse. When the planet is at point A,
- its speed is constant.
 - its speed is increasing.
 - its speed is decreasing.
 - its speed is a maximum.
 - its speed is a minimum.
- 
9. The rotor of a helicopter turns at an angular speed of 450 revolutions per minute (rpm). What is this angular speed in radians per second?
- 45π rad/s
 - 900π rad/s
 - 450π rad/s
 - 90π rad/s
 - 15π rad/s
10. A book rests on a horizontal table. The table prevents the book from falling through it. Which force is responsible for this support?
- Gravitational force pulling the book downward
 - Frictional force between the book and the table
 - Normal force exerted by the table on the book
 - Tension force acting within the book's pages
 - Applied force from the air molecules around the book

SECTION B

There are 15 short-answer questions. Each question is worth 2 marks. You are advised not to spend more than 45 minutes in this section. All questions are compulsory.

1. Hooke's Law states that the force, F , in a spring extended by a length x is given by $F = -kx$. From Newton's second law, $F = ma$, where m is the mass and a is the acceleration, find the units of the spring constant k .
2. A ball is projected horizontally from the top of a building. One second later, another ball is projected horizontally from the same point with the same velocity. Explain at what point in the motion the balls will be closest to each other.
3. If the velocity of a particle is zero, can the particle's acceleration be zero? Explain.
4. Grace is standing inside a stationary bus in front of Shriya, who is seated. The bus suddenly starts moving forward, and Grace falls into Shriya's lap. Explain why this happens?
5. In a tug-of-war between two athletes, each pulls on the rope with a force of 200 N. Explain what the tension is in the rope?
6. Torque and Work have the same fundamental dimensions but are completely different physical quantities. Explain how these two quantities are different from each other.
7. Taniela slams on his car brakes to avoid colliding with a stray dog crossing the highway. What happens to the car's kinetic energy as it comes to rest?
8. Tarzan swings from a long vine to save Jane stranded at the bottom of the swing. After the catch, they both continue together on the swing. Explain how Tarzan's speed after catching Jane changes and compare the heights of the swing before and after the collision.
9. Explain why a head-on collision is likely to be more dangerous than other types of collisions.
10. An air bag inflates when a collision occurs, protecting a passenger from serious injury. How does the airbag reduce the blow?
11. Describe the path of an object moving with a constant acceleration perpendicular to its velocity.
12. If global warming continues, it's likely that some ice from the polar ice caps of the Earth will melt, and the water will be distributed closer to the equator. If this occurs, would the length of the day (one revolution) increase, decrease, or remain the same? Explain.
13. An ideal gas occupies a volume of 1.00 cm^3 at 20°C at 1 atm. Determine the number of molecules of gas in the container.
14. For an ideal gas in an isothermal process, there is no change in internal energy. Suppose the gas does work, W , during such a process. How much energy is transferred by heat?
15. State the *Second Law of Thermodynamics*.

Section C

There are 6 long-answer questions. Each question is worth 10 marks. You are advised not to spend more than 120 minutes in this section. **All questions are compulsory.**

QUESTION 1

- a) The period of a spring-mass system oscillating on a frictionless surface is given by:

$$T = 2\pi\sqrt{\frac{m}{k}} \quad \text{where;}$$

m is the oscillating mass, and k is the spring constant.
Show that the equation is dimensionally consistent.

[4 marks]

- b) A jet plane does an emergency landing with a speed of 110 ms^{-1} and accelerates at -5.00 ms^{-2} as it attempts to rest at Waiqele Airport in Labasa.

- i. From the instant the plane touches the runway, what is the time needed before it can come to a complete stop for passengers to evacuate?

[3 marks]

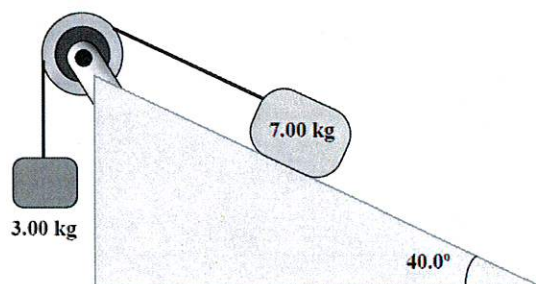
- ii. The runway in Labasa is 0.900 km long. Using reasoning, show whether the jet plane will come to a safe stop.

[3 marks]

QUESTION 2

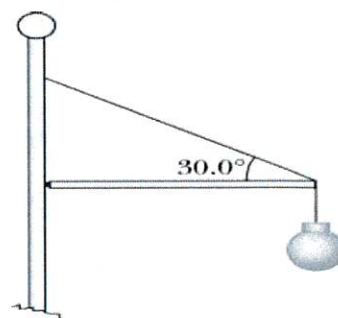
- a) Find the acceleration experienced by each of the two objects as shown. The coefficient of kinetic friction between the 7.00 kg object and the plane is 0.250. Assume the pulley and the string have negligible mass.

[5 marks]



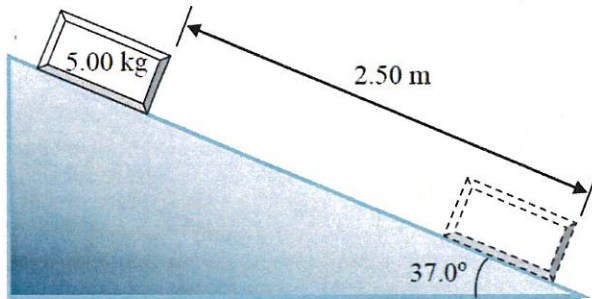
- b) A 20.0 kg floodlight is supported at the end of a horizontal beam of negligible mass that is hinged to a pole as shown. A cable at an angle of 30.0° with the beam helps to support the light. Find the tension in the cable and the horizontal and vertical components of the reaction force exerted by the pole on the beam.

[5 marks]



QUESTION 3

- a) A 5.00 kg block initially at rest slides 2.50 m down an inclined plane as shown. The coefficient of kinetic friction between the block and the incline is $\mu_k = 0.436$.



- i. Determine the work done by the force of gravity and by the friction force.

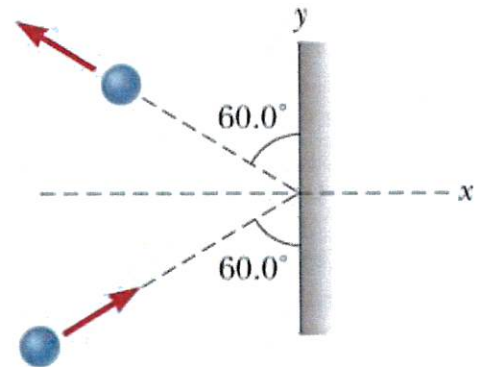
[3 marks]

- ii. State the work-kinetic energy theorem and hence determine the speed of the block at the end of 2.50 m.

[2 marks]

- b) A 3.00 kg steel ball strikes a massive wall at 10.0 m s^{-1} at an angle of 60° with the plane of the wall. It bounces off the wall with the same speed and angle as shown in the figure. If the ball is in contact with the wall for 0.200 s, what is the average force exerted by the wall on the ball?

[5 marks]



QUESTION 4

- a) Veronica's washing machine goes into the spin-dry cycle, starting from rest and reaching an angular speed of 5.00 rev s^{-1} in 8.00 s. At this point, Veronica opens the lid, and a safety switch turns off the washer. The tub slows to rest in 12 s. Assuming a constant angular acceleration throughout, find:

- i. the angular displacement in the first 8.00 s.

[2 marks]

- ii. the angular displacement after Veronica opens the lid, and

[2 marks]

- iii. the total number of revolutions during the entire 20.0 s period.

[1 mark]

- b) A solid, horizontal cylinder [$I = \frac{1}{2} MR^2$] of mass 10.0 kg and radius 120 cm rotates with an angular speed of 15 rpm about a fixed vertical axis through its center. A 250-gram piece of putty is dropped vertically onto the cylinder at a point 90 cm from the center of rotation and sticks to the cylinder. Determine the final angular speed of the system.

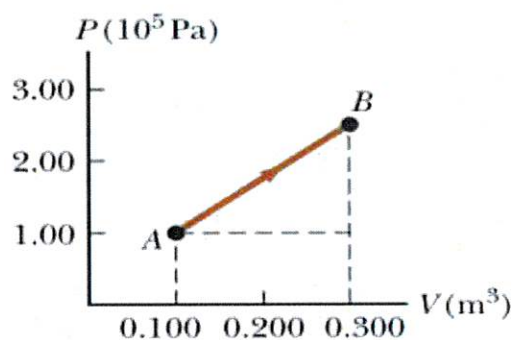
[5 marks]

QUESTION 5

- a) A satellite moves in a circular orbit around Earth at a speed of 5000 ms^{-1}
- Determine the satellite's altitude above the surface of the Earth, and; [3 marks]
 - Calculate the period of the satellite's orbit. [2 marks]
- b) A cylinder contains 2.00 mol of helium gas at 20.0°C . Assume the helium behaves like an ideal gas.
- What is the average kinetic energy of one molecule and hence, find the total internal energy of the system? [3 marks]
 - How much energy must be added to double the rms speed? [2 marks]

QUESTION 6

- a) A 5.00 kg block of ice at 0°C is added to an insulated container partially filled with 10.0 kg of water at 15°C . Determine the mass of ice that has melted and hence find the final temperature of the water. [3 marks]
- b) A quantity of 4.00 mol of a monatomic ideal gas expands from an initial volume of 0.100 m^3 to a final volume of 0.300 m^3 and a pressure of $2.50 \times 10^5 \text{ Pa}$ as shown in the PV diagram. Determine:
- the work done on the gas and the change in the internal energy of the gas. [3 marks]
 - the thermal energy transferred to the gas. [2 marks]



- c) A steam engine has a boiler that operates at 1000 K . The heat changes water to steam, which drives a piston. The temperature of the exhaust is 300 K . What is the maximum possible thermal efficiency of this steam engine?

[2 marks]

THE END

USEFUL FORMULAS

1. $F = ma$

2. $v = u + at$

3. $s = ut + \frac{1}{2}at^2$

4. $v^2 = u^2 + 2as$

5. $KE = \frac{1}{2}mv^2$

6. $p = mv$

7. $P = \frac{W}{t} = Fv$

8. $W = Fd \cos \theta = \Delta E$

9. $PE = mgh$

10. $E_{\text{spring}} = \frac{1}{2}kx^2$

11. $F = G \frac{m_1 m_2}{r^2}$

12. $g = \frac{GM}{R^2}$

13. $v = \sqrt{\frac{GM}{R}}$

14. $T = \frac{2\pi R}{v}$

15. $F_c = \frac{mv^2}{r}$

16. $v_e = \sqrt{\frac{2GM}{R}}$

17. $\tau = I\alpha$

18. $P = \sigma \epsilon AT^4$

19. $KE_r = \frac{1}{2}I\omega^2$

20. $L = I\omega$

21. $\Delta L = \alpha L \Delta T$

22. $\Delta V = \beta V \Delta T$

23. $PV = nRT$

24. $P = \frac{Nk_B T}{V}$

25. $Q = mc\Delta T$

26. $Q = mL$

27. $W = P\Delta V$

28. $\frac{Q}{t} = kA \frac{\Delta T}{L}$