Kuwait University Physics Department

جامعة الكويت
KUWAIT UNIVERSITY

Physics 101

Summer Semester

Second Midterm Exam

Saturday, July 11, 2026

10:00 AM – 11:30 AM

Student's Name: …… Serial Number: ……

Student's Number: ……Section: ……

Choose your Instructor's Name:

Instructors: Drs. Al Dosari, Al Jassar, Al Qattan, Al Smadi, Askar, Salameh, Zaman

For Instructors' use only

Grades:

#	SP1	SP2	SP3	SP4	SP5	LP1	LP2	MC	Total
Pts	2	2	2	2	2	3	3	4	20

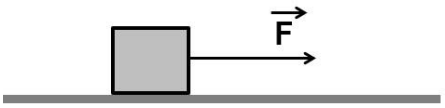
Important:

1. Answer all questions and problems (No solution = no points).
2. Full mark = 20 points as arranged in the above table.
3. **Give your final answer in the correct units.**
4. Assume g = 10 m/s^2.
5. Mobiles are **strictly prohibited** during the exam.
6. Programmable calculators, which can store equations, are not allowed.
7. **Cheating incidents will be processed according to the university rules.**

GOOD LUCK

Part I: Short Problems (2 points each)

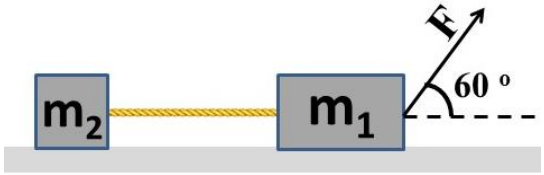
SP1. A constant horizontal force $|\vec{F}| = 120\ N$ is applied to a $20\ kg$ block moving on a **rough** horizontal surface ($\mu_k = 0.5$), as shown. **Find the magnitude of the block's acceleration.**



For m: $F - f_k = ma$

$$a = \frac{120 - 0.5(200)}{20} = 1\ m/s^2$$

SP2. Two blocks ($m_1 = 8\ kg, m_2 = 4\ kg$), are connected by a light rope and pulled by a force $|\vec{F}| = 70\ N$, along a horizontal **frictionless** surface, as shown. **Find the magnitude of the tension (*T*) in the string**.



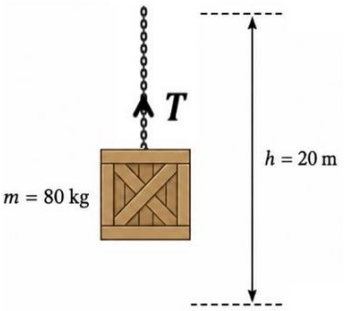
For m_1: $F\ cos\ 30^o - T = 8a$

For m_2: $T = 4a$

$$F\ cos\ 60^o - T = 2T$$

$$T = \frac{F \cos 60^o}{3} = 11.7\ N$$

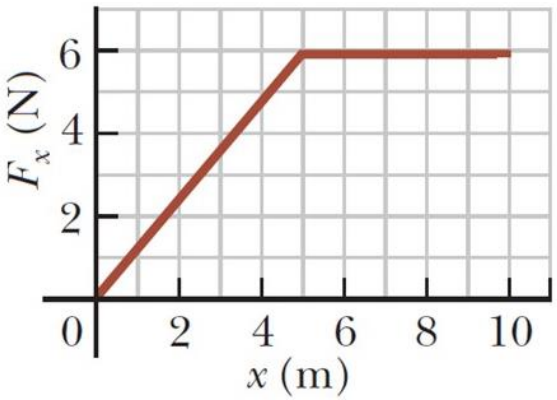
SP3. What is the **average power** required to lift a box of mass $m = 80\ kg$ **vertically** through a height of $h = 20\ m$ in $t = 40\ s$ at a **constant speed?**



$$W = mgh = (80)(10)(20) = 16000\ J$$

$$P_{av} = \frac{W}{t} = \frac{16000}{40} = 400\ W$$

SP4. A 2 kg block is subject to a single force $\boldsymbol{F_x}$ that varies with position as shown. If the speed of the block at $x = 0\ m$ is 6 m/s, **find its speed at $x = 10\ m$.**



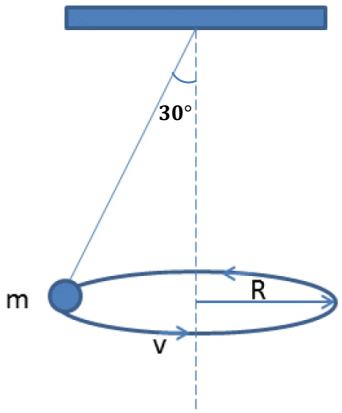
$W_{total} = \Delta K$

$\frac{1}{2}(5)(6) + (5)(6) = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$45 = v_f^2 - (6)^2$

$v_f = 9\ m/s$

SP5. A ball of mass ($m = 4\ kg$) is attached to a string and rotates in a **<u>horizontal</u>** circle with **<u>constant speed</u>** ($v = 1.7\ m/s$). The string makes an angle ($\theta = 30°$) with the vertical, as shown. **Find the <u>radial force</u> acting on the ball.**



For m: $T\cos\theta = mg$

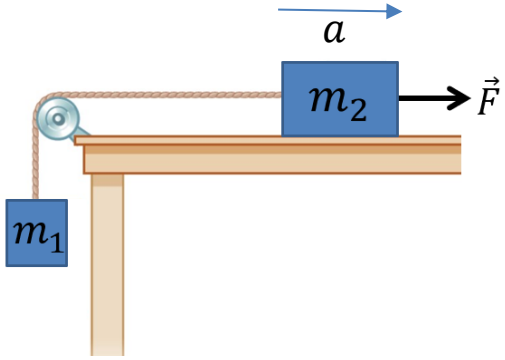
$$T = \frac{mg}{\cos\theta} = \frac{40}{\cos 30^o} = 46.2\ N$$

$F_r = T\sin\theta = 46.2\sin 30^o = 23.1\ N$

Part II: Long Problems (3 points each)

LP1. Two blocks ($m_1 = 2\ kg, m_2 = 4\ kg$) are connected by a light rope passing over a massless, frictionless pulley. The horizontal surface is **frictionless** and a constant force $\vec{F}$ is applied to m_2, causing the system to accelerate at $|\vec{a}| = 0.5\ m/s^2$, as shown.

a) Find the magnitude of the applied force $\vec{F}$.



for M_{total}: $\sum F = M_{total}a$

$F - m_1 g = M_{total}a$

$F - 20 = 6(0.5)$

$F = 23\ N$

b) Find the tension (T) in the rope.

For m_2: $\sum F = m_2 a$

$F - T = m_2 a$

$23 - T = 4(0.5)$

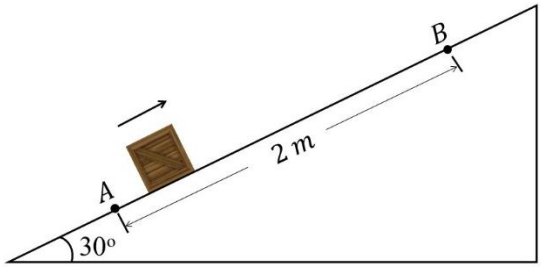
$T = 21\ N$

c) If the applied force $\vec{F}$ is **removed**, what happens to the **tension (T)** in the rope **immediately after removal?**

* T increases (*) T decreases * $T = 0$

LP2. A 4 kg block is given an initial speed of 6 $m/$s at point **A**. The block slides up **a rough** incline and completely stops at point B.

a) Find the total work done on the block as it moves from A to B.



$$\sum W = \Delta K = \frac{1}{2}m(V_B^2 - V_A^2) = -72\ J$$

b) Using the work-kinetic energy theorem, find the coefficient of kinetic friction (μ_k) between the block and the incline.

$$\sum W = W_g + W_n + W_{fk}$$
$$-72 = -4(10)(2\ sin(30^o) + 0 - \mu_k 4(10)cos(30^o)(2)$$
$$\mu_k = 0.46$$

c) Find the coefficient of static friction (μ_s), required to keep the block at <u>rest</u> at point B.

$$\sum F = 0$$
$$mg\ sin(30^o) = \mu_s mgcos(30^o)$$
$$\mu_s = tan(30^o) = 0.58$$

Part III: Questions (Choose the correct answer, one point each)

Q1. In a **uniform** circular motion, **the vectors that point toward the center** of the circular path are**:**

(*) acceleration and net force.

* velocity and acceleration.

* velocity and net force.

* velocity, acceleration, and net force.

Q2. A boy with mass (m) stands on a scale in an elevator. **While the elevator is moving downward but slowing down,** which one of the following is correct?

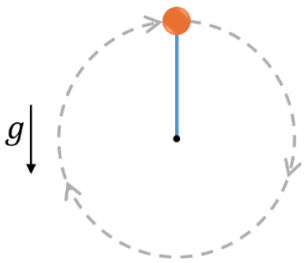
* $n < mg$

* $n = mg$

(*) $n > mg$

* $n = 0$

Q3. A ball of mass m, attached to a light string of length L, moves in a **vertical circle** as shown. What is the **work** done by the gravitational force **(W_g)** on the ball during **one complete revolution?**



* $W_g > 0$

(*) $W_g = 0$

* $W_g < 0$

* $W_g = 2mgL$

Q4. A block of mass m is moving with a speed v. Its kinetic energy is K. If the **speed** of the block is **doubled** while its mass remains unchanged, **what will be its new kinetic energy?**

* $2K$

(*) $4K$

* $8K$

* $K/2$