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BIRZEIT UNIVERSITY

Physics 141

Fall 2022-2023

Second Hour Exam

Time: 75 minutes

Student Name: Ru'ad Srour

Student No.:

هام: يرجى قراءة هذه التعليمات بتمعن قبل بدء الامتحان

يمنع منعاً باتاً استخدام الهاتف النقال ووضع سماعات أذن أثناء الامتحان، ويجب إطفاء الهاتف ووضعه داخل الحقيبة، علماً أن عدم الالتزام بذلك يعتبر غشاً أكاديمياً ويتعرض فاعله للعقوبة الأكاديمية حسب أنظمة وقوانين الجامعة.

1. أكتب اسمك ورقمك الجامعي في المكانين المخصصين لذلك أعلاه.
2. ضع دائرة حول رقم حصة النقاش المسجل بها في الجدول التالي، **سيتم خصم 3 علامات لمن لا يختار رقم الشعبة أو يختار الشعبة الخاطئة.**

Instructor	Discussion No.	Instructor	Discussion No.
Ismael Badran	1, 3	Shayma' Salama	11
Hana' Bashir	2, 16, 18, 20	Rula Bakeer	14, 17, 19
Tareq Afaneh	4, 8, 13	Nour Maraytah	6, 7, 15
Aziz Shawabkeh	5, (10), 12	Rand Aqra	9

10:00 ← الدكتور

3. يحتوي الامتحان على 18 سؤال اختيار من متعدد، أنقل أجوبة الأسئلة في الجدول المرفق وذلك بوضع إشارة (X) بقلم الحبر في الخانة المناسبة.
4. عند انتهاء الامتحان، سلم جميع أوراق الامتحان كاملة إلى المراقب.
5. لا يسمح باستخدام أوراق خارجية للحل، ويوجد ورقتين إضافيتين في آخر الامتحان لهذا الغرض.

A /Q #	1	2	3	4	5	6	7	8	9	10
(a)	X	X			X					
(b)				X					X	
(c)			X			X				
(d)							X			X
(e)								X		

A /Q #	11	12	13	14	15	16	17	18		
(a)										
(b)	X				X					
(c)						X		X		
(d)			X	X						
(e)		X					X			

USEFUL CONSTANTS AND FORMULA

$g = 10\ m/s^2$

Friction and Drag forces

1. $f_k = \mu_k N$
2. $f_{s,max} = \mu_s N$
3. $F_d = \frac{1}{2} C\rho A v^2$ *(drag force)*

Work and power

4. $F = -kx$
5. $W = \vec{F} \cdot \vec{d}$ *(work done by a constant force)*
6. $W = \int_a^b f(x)dx$, *(work done by a variable force)*
7. $\bar{P} = \frac{W}{\Delta t}$, *(Average power)*
8. $P = \vec{F} \cdot \vec{v}$,*(Instantaneous power)*
9. $\Delta K = W$, *(Work Kinetic Energy theorem)*

Kinetic, potential and total energy

10. $K = \frac{1}{2} m v^2$
11. $U = mgh$, *(gravitational potential energy)*
12. $U = \frac{1}{2} kx^2$ *(elastic potential energy)*
13. $E_m = K + U$ *(Mechanical energy)*
14. $\Delta U = -\int_a^b f(x)dx$ *(Change in potential energy)*
15. $\Delta E_{tot} = \Delta E_m + \Delta E_{th} = 0$, *(isolated system)*

Linear momentum and center of mass

16. $\vec{P} = m\vec{v}$, *(Linear momentum)*
17. $x_{com} = \frac{\sum_i m_i x_i}{\sum_i m_i}$, *(Center of mass of discrete system*
18. $\vec{J} = \int_{t_i}^{t_f} \vec{f}(t)dt$, *(Impulse)*
19. $v_{1f} = \frac{(m_1 - m_2)}{(m_1 + m_2)} v_{1i} + \frac{2m_2}{(m_1 + m_2)} v_{2i}$
20. $v_{2f} = \frac{2m_1}{(m_1 + m_2)} v_{1i} + \frac{(m_2 - m_1)}{(m_1 + m_2)} v_{2i}$

1. A wooden block of mass m = 5 kg placed on a horizontal table. the coefficient of static and kinetic friction between the block and the table are $\mu_s = 0.5$ and $\mu_k = 0.3$. A horizontal force F=12 N acts on the block. The frictional force between the block and the table is:

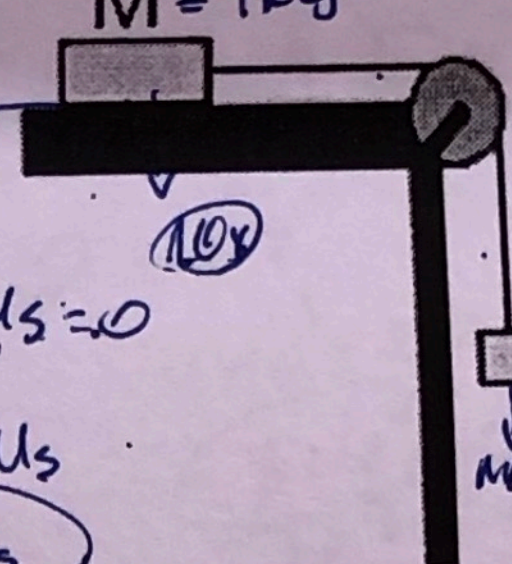
(a) 12 N
(b) 30 N
(c) 20 N
(d) 25 N
(e) 15 N

2. At what angle should a 50 m radius icy roadway be banked (تميل) to allow cars to turn the curve at maximum speed of 15 m/s?

(a) 24.2°
(b) 20.0°
(c) 10.3°
(d) 16.1°
(e) 12.5°

3. A box of mass M = 1.00 kg is placed on a rough surface and is connected by a massless string to a box of mass m = 0.40 kg as shown in the figure. The minimum coefficient of static friction needed to prevent block M from sliding is:

(a) 0.65
(b) 0.50
(c) 0.40
(d) 0.35
(e) 0.75

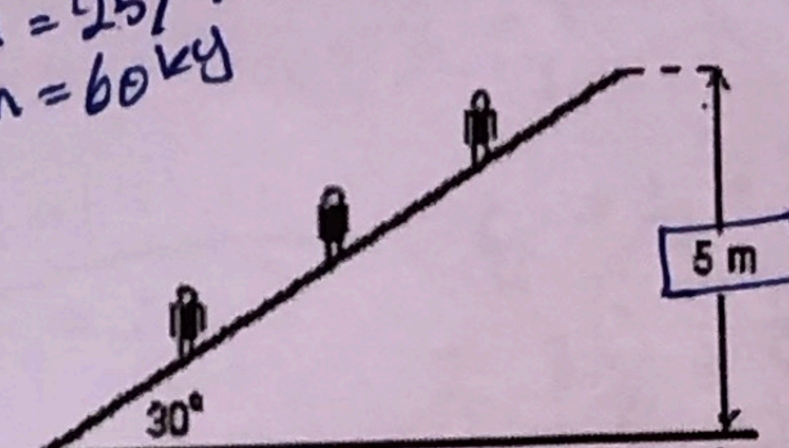


4. If the effective area of a falling object is reduced to half its initial value, then the ratio of the new terminal speed of the object to the original terminal speed will be

(a) 0.58
(b) 1.41
(c) 2.00
(d) 1.00
(e) 0.71

5. An escalator (مصعد كهربائي) is used to move 25 people (60 kg per person on the average) per minute from the first floor of a department store to the second floor, 5 m above. The power of the escalator's motor required should be at least

(a) 1250 Watt
(b) 1000 Watt
(c) 1500 Watt
(d) 1400 Watt
(e) 1800 Watt



6. A particle is being acted upon by a constant force F = 2i + 3j-k N. The force moves the particle from the origin (0,0,0) to the point (4m, 5m, 0m). The work (in Joules) done on the particle by this force is

(a) 6 J
(b) 12 J
(c) 23 J
(d) -10 J
(e) 2 J

7. An 100-N box slides with constant speed a distance of 5.0 m downward a rough incline that makes an angle of 30° with the horizontal. The work done by the force of friction is:

(a) -125 J
(b) 100 J
(c) -200 J
(d) -250 J
(e) 0 J

8. A car travels with a constant speed of 20 m/s. The car's engine produces a 4000 N pushing force in order to keep the speed constant. How much power is developed by the engine?

(a) 40 kW
(b) 20 kW
(c) 50 kW
(d) 60 kW
(e) 80 kW

9. A wooden block is attached to an ideal spring with a spring constant of 20 N/m oscillates on a horizontal frictionless surface. The total mechanical energy of the system is 0.9 J. The block reaches a maximum distance from the relaxation point of

(a) 1.0 m
(b) 0.3 m
(c) 0.2 m
(d) 1.5 m
(e) 0.1 m

10. The potential energy function of a particle is given by $U(x) = 2x^2 + x + 3$. The mechanical energy of the particle is 4 J. Find the turning points of the particle.

(a) +1.0 m, - 1.0 m
(b) +1.5 m, - 2.0 m
(c) +1.5 m, - 1.5 m
(d) +0.5 m, - 1.0 m
(e) +2.0 m, - 2.5 m

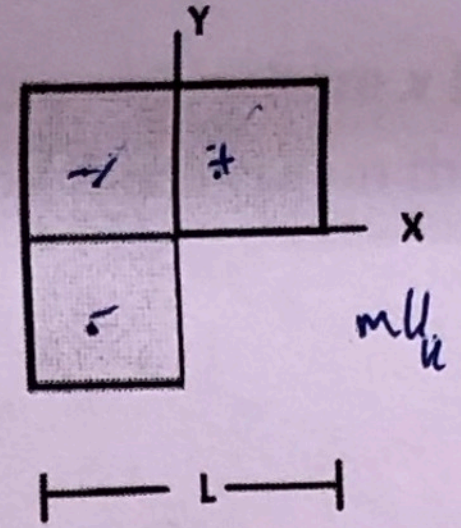
11. A 2 kg block is moved up a 2.5 m inclined plane at an angle of 30 degrees with the horizontal. The change in the gravitational potential energy of the block is

(a) +50.0 J
(b) -50.0 J
(c) +25.0 J
(d) -20.0 J
(e) +30.0 J

12. A 1 kg wooden block is placed on a table compresses an ideal spring with a spring constant of 300 N/m for 10 cm. When released, the block stopped due friction in a distance of 50 cm. The coefficient of kinetic friction between the block and the table is

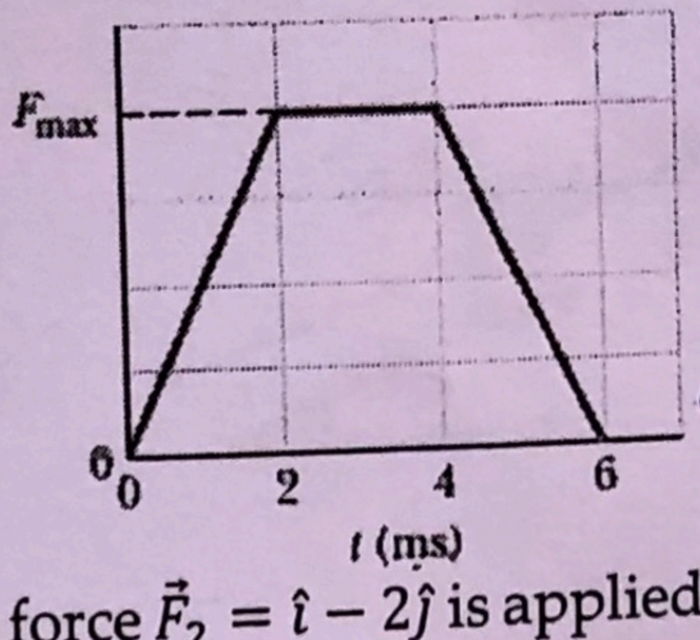
(a) 0.6
(b) 0.4
(c) 0.5
(d) 0.3
(e) 0.2

13. A square sheet of metal of length L is divided into 4 equal quarters. One quarter is removed as shown in the figure. What are the x-coordinate and the y-coordinate of the center of mass of the remaining sheet of metal. Take L=24 cm.



(a) $x_{com} = -1\ cm,\ y_{com} = 1\ cm$
(b) $x_{com} = 1\ cm,\ y_{com} = -1\ cm$
(c) $x_{com} = 1\ cm,\ y_{com} = -2\ cm$
(d) $x_{com} = -2\ cm,\ y_{com} = 2\ cm$
(e) $x_{com} = -3\ cm,\ y_{com} = 3\ cm$

14. A 20 g ball hits a vertical wall perpendicularly with a speed of 20 m/s and rebounds in the opposite direction with the same speed. The adjacent graph shows the force acting on the ball (in Newtons) during its contact time (in milliseconds) with the wall. What is the maximum force on the ball (F_{max}) from the wall?



(a) 300 N
(b) 100 N
(c) 400 N
(d) 200 N
(e) 160 N

15. A force $\vec{F}_1 = 2\hat{\imath} + 3\hat{\jmath}$ is applied to a 2.50 kg mass, and another force $\vec{F}_2 = \hat{\imath} - 2\hat{\jmath}$ is applied to a second 0.50 kg mass. The acceleration of the center of mass of the two-particle system is

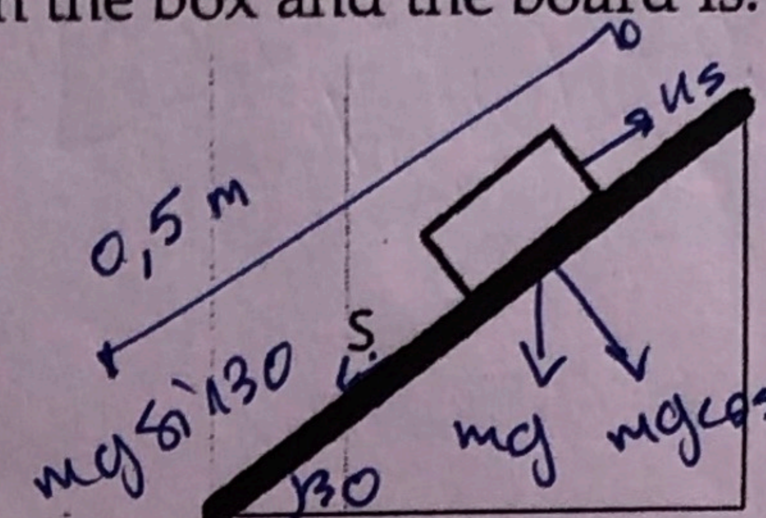
(a) $\vec{a}_{com} = 0.75\hat{\imath} + 0.25\hat{\jmath}\ m/s^2$
(b) $\vec{a}_{com} = 1.00\hat{\imath} + 0.33\hat{\jmath}\ m/s^2$
(c) $\vec{a}_{com} = 1.50\hat{\imath} + 0.50\hat{\jmath}\ m/s^2$
(d) $\vec{a}_{com} = 3.00\hat{\imath} + 1.00\hat{\jmath}\ m/s^2$
(e) $\vec{a}_{com} = 1.33\hat{\imath} + 0.50\hat{\jmath}\ m/s^2$

16. A 2 kg block moving along the x-axis with a speed of 2 m/s exploded (انفجرت) into two equal masses. The first mass is moving with a velocity $\vec{v}_1 = 2\hat{\imath} + 3\hat{\jmath}$. The second mass will be travelling with a velocity of

(a) $\vec{v}_2 = 4.0\hat{\imath} - 3.0\hat{\jmath}$ m/s
(b) $\vec{v}_2 = 4.0\hat{\imath} + 3.0\hat{\jmath}$ m/s
(c) $\vec{v}_2 = 2.0\hat{\imath} - 3.0\hat{\jmath}$ m/s
(d) $\vec{v}_2 = 60\hat{\imath} - 3.0\hat{\jmath}$ m/s
(e) $\vec{v}_2 = 2.0\hat{\imath} + 3.0\hat{\jmath}$ m/s

17. A box rests on a rough board of length S = 50 cm. When one end of the board is slowly raised to a height h = 25 cm above the other end, the box will be on the verge of sliding down the board. The coefficient of static friction between the box and the board is:

(a) 0.75
(b) 0.25
(c) 0.44
(d) 0.80
(e) 0.58



18. A force $F = 3x^2 - 2x + 1$ acts on a block and moved it from $x = 0$ to $x = 2$, where x is measured in meters and F is in Newtons. The work (in Joules) done by this force on the block is

(a) 45 J
(b) 52 J
(c) 6 J
(d) 12 J
(e) 21 J