Final

Physics Dept.

Physics 141

FINAL EXAM **1st Semester**

Time: 2:30 hours

Student Name: _____ **Student NO:** _____

ضع علامة (X) هنا	Instructor Name	Section No.	Class Time
	Tayseer Arouri	2D	MW 9-9:50
	Wafaa Kahter	3D	SM 10-11:00
	Yaqub Anini	4D	SM 11-12:00
	Wafaa Khater	6D	SM 1-2:00
	Tayseer Arouri	7D	MW 2-3:00
	Yaqub Anini	8D	SW 8-8:50
	Yaqub Anini	9D	SM 10-11:00
	Esmael Badran	10D	SM 11-12:00
	Wafaa Kahter	11D	MW 12-1:00
	Esmael Badran	12D	SM 1-2:00

Answer Sheet:

No.	a	b	c	d
1				
2				
3				
4				
5				
6				
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15				

No:	a	b	c	d
16				
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25				

Exam Instructions:

1) Answer all questions.
2) Fill your answers in the answer sheet.
3) $g = 10 \frac{m}{s^2}$

1) The nanometer ($1\ nm = 10^{-9}\ m$) is a unit used to measure very short distances. How many centimeters are there in one nanometer?

a) 10^{-7} b) 10^{-6} c) 10^{-8} d) 10^{-12}

2) An electron moving along the x axis has a position given by $x = 4te^{-2t}$. What is the value of its acceleration when it momentarily stops?

a) zero b) $-2e^{-1}$ c) $-8e^{-1}$ d) $-4e^{-1}$

$x = 4te^{-2t}$ $\frac{dx}{dt} = 4e^{-2t} - 2 + 4te^{-2t}$

$= -8te^{-2t} + 4te^{-2t}$

$\frac{dx}{dt} = -16te^{-2t} + -8e^{-2t}$

$-8(2te^{-2t} + e^{-2t}) =$

$-8(3e^{-2t}) = 0$

$-24e^{-2t} = 0$

3) Water drips from a faucet (قطرات ماء تسقط من حنفية) onto the floor 200 cm below. The drops(قطرات) fall at regular (equal) intervals of time, the first drop striking the floor at the instant the fourth drop begins to fall. Find the location of the second drop when the first strikes(تصطدم) the floor?

a) 22 cm b) 45 cm c) 89 cm d) 71 cm

4) A displacement vector has a magnitude of 12 meters at an angle of 3 radians from the positive x-axis. The x-component of this vector is

a) -4 m b) -11.9 m c) -7.8 m d) -5 m

5) If vector $\mathbf{a} = \mathbf{i}+\mathbf{j}+\mathbf{k}$, and vector $\mathbf{b} = 3\mathbf{k}-2\mathbf{j}$, a unit vector $\mathbf{c}$ in the direction of $\mathbf{b}-\mathbf{a}$ is

a) $2\mathbf{k}-3\mathbf{j}-\mathbf{i}/\sqrt{14}$ b) $\mathbf{k}-3\mathbf{j}-\mathbf{i}/\sqrt{11}$ c) $3\mathbf{i}+3\mathbf{j}+3\mathbf{k}/3$ d) $2\mathbf{k}-2\mathbf{j}-\mathbf{i}/3$

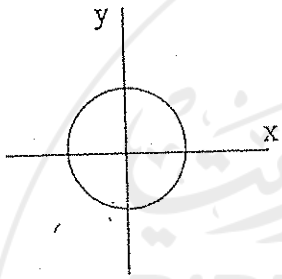
$\mathbf{a} = \mathbf{i}+\mathbf{j}+\mathbf{k}$ $\mathbf{b} = 3\mathbf{k}-2\mathbf{j}$

$\mathbf{b}-\mathbf{a} = 0\mathbf{i}-2\mathbf{j}+2\mathbf{k} - \mathbf{i}+3\mathbf{j}+2\mathbf{k}$

6) If vector a=2i-3k, vector b=j+i, and vector c=2i, what is (2a X b)· 3c?

a) 36 b) 12 c) 18 d) 6

7) The figure shows a circular path taken by a particle. If the instantaneous velocity of the particle is v = -2i -2j, through which quadrant is the particle moving when it is traveling clockwise?



a) Third b) Fourth c) First d) Second

8) A ball is thrown from the ground into the air. At a height of 8 m, its velocity is v= 3i+ 4j in meters per second (i horizontal, j vertical). To what maximum height does it rise?

a) 8.2 m b) 8.5 m c) 9.2 m d) 8.8 m

9) Two ships, A and B, leave port(الميناء) at the same time. Ship A travels at 50 km/h north, and ship B travels at 40 km/h west. What is the velocity of ship A relative to ship B?

a) 58km/h, 59° N of E
b) 67km/h, 48° N of E
c) 61km/h, 45° N of E
d) 64km/h, 51° N of E

10) The weight of a man on earth is 800 N. What is his weight on the moon ($g_{moon} = g_{earth}/6$)?

a) 800N b) 133N c) 117N d) 100N

11) A motorcycle and a 70 kg rider accelerate at 2 m/s^2 up a slope inclined 20° above the horizontal. What is the magnitude of the force on the rider from the motorcycle?

a) 760 N b) 800N c) 740N d) 140N

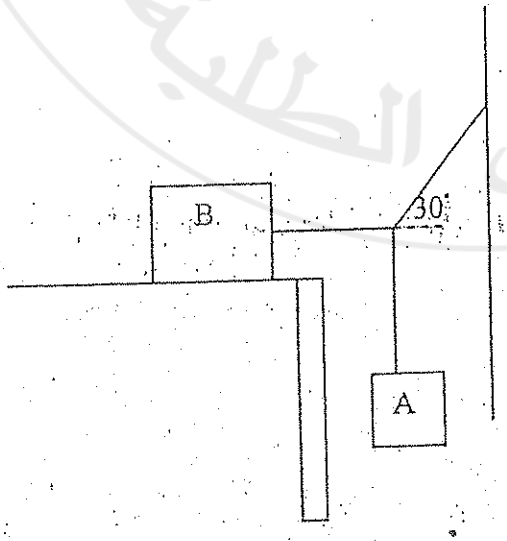
12) An 80 kg man is parachuting with a downward acceleration of 1.5 m/s^2. The mass of the parachute is 5 kg. What is the downward force on the parachute from the person?

a) 680 N b) 600N c) 7.5N d)640N

13) A 900 kg car sliding over ice is stopped in 150 m by a frictional force on it from the ice. If the initial speed of the car is 15 m/s, the coefficient of friction between the car and the ice is?

a) 0.3 b) 0.13 c) 0.075 d) 0.2

14) Block B in the figure is stationary and weighs 680 N. The coefficient of static friction between it and the table is 0.25. The maximum weight of block A for which the system is stationary is



a) 79N b) 98 N c) 53N d) 39 N

15) Suppose the coefficient of static friction between the road and the wheels of a car is 0.6. What car speed will put the car on the verge of sliding(على وشك الإنزلاق) when it rounds a level curve(منعطف مستوي) of 35m radius?

a) 16.4 m/s b) 18.5 m/s c) 13.2 m/s d) 14.5 m/s

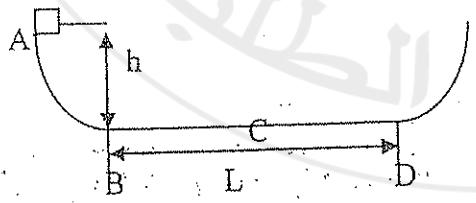
16) A 5 kg body has a velocity of $\mathbf{v} = \mathbf{i} - 2\mathbf{j}$. Its kinetic energy is

a) 5 J b) 20 J c) 12.5 J d) 32.5 J

17) What work is done by a force $\mathbf{F} = 2x\mathbf{i} - 3\mathbf{j}$, with x in meters, that moves the particle from position (2,3) to position (-4,-3)?

a) 30 J b) 27 J c) 24 J d) zero

18) A particle travels along the track shown in the figure. The curved parts of the track are frictionless. The flat part, of length L, has a coefficient of kinetic friction of 0.1. The particle is released from rest at point A, which is a height of h=L/2. Where does the particle finally stop?



a) point C(middle) b) point B c) point D d) non of the above

19) A potential-energy function for a two dimensional force is of the form U= $3x^3y-7x$. The force that acts at the point (x,y) is

a) $(-9x^2y+7)\mathbf{i} -3x^3\mathbf{j}$ b) $(-9x^2y+6)\mathbf{i} -3x^3\mathbf{j}$ c) $(-9x^2y+5)\mathbf{i} -3x^3\mathbf{j}$ d) $(9x^2y-7)\mathbf{i} +3x^3\mathbf{j}$

20) A ball of mass 0.3 kg has a velocity of 150 **i** m/s. A ball of mass 0.2 kg has a velocity of -100 **i** m/s. They meet in a head-on collision. The velocity of their center of mass is

a) 30 **i** m/s b) 50 **i** m/s c) zero d) -6.3 **i** m/s

21) A 6100 kg rocket is set for vertical launching (إطلاق عمودي من سطح الأرض)from the ground. The exhaust speed(سرعة الغازات المنبعثة) is 1200 m/s. How much gas must be ejected (ينبعث) each second if the thrust(قوة الدفع) is equal to the force of gravity on the rocket?

a) 51 kg/s b)48 kg/s c) 44 kg/s d) 41 kg/s

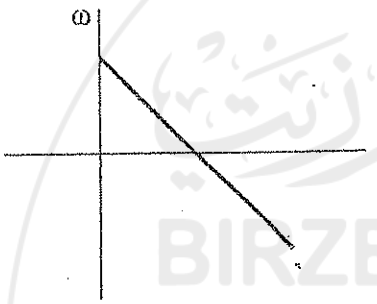
22) After a completely inelastic collision, two objects of the same mass and same initial speed are found to move away together at one-half of their initial speed. The angle between the initial velocities of the objects is

a) 60° b) 30° c) 45° d) 120°

23) A wheel has a rotational kinetic energy of 5000 J, and rotates at 500 rev/min. Its rotational inertia(I) is

a) 5.7 kgm^2 b) 2.5 kgm^2 c) 10 kgm^2 d)3.7 kgm^2

24) The figure shows the angular velocity of a rotating wheel versus time. Which of the following statements is correct?



a) the wheel never stops rotating
b) the angular acceleration of the wheel is negative
c) the angular acceleration of the wheel changes from positive to negative
d) the wheel rotates clockwise all the time.

25) A car accelerates uniformly from rest and reaches a speed of 22m/s in 9 seconds. If the diameter of the car wheels is 58 cm, the final angular speed of the wheel in revolutions per second is

a) 5 rev/s b) 22 rev/s c)6 rev/s d) 4 rev/s

BIRZEIT UNIVERSITY

Physics 151

2nd semester

Final Exam

Time: 2½ Hours

Student Name: _____ Student No.: _____

Instructors (check one)

☐ AROURI ☐ ABU-SHAMA'

Coordinator: AROURI, T.

تعليمات:

١) ابدأ بكتابة اسمك ورقمك ورقم الشعبة وحدد اسم الاستاذ في المربع المناسب في أعلى هذه الصفحة.

٢) اختر الجواب الصحيح وانقله الى هذه الصفحة وذلك بوضع اشارة (X) في الخانة المناسبة.

٣) اذا وضعت اكثر من اجابة واحدة لنفس السؤال لن يعطى علامة صفر.

٤) يجب اعادة أوراق الامتحان كاملة.

٥) العلامة الكاملة تحتسب لـ (٢٧) سؤالا من اصل ٣١ سؤالا يتضمنها الامتحان.

	Answer Sheet				
1	a	X	c	d	e
2	X	b	c	d	e
3	a	X	c	d	e
4	a	b	X	d	e
5	a	b	c	X	e
6	X	b	c	d	e
7	a	b	X	d	e
8	a	b	c	X	e
9	a	b	c	d	X
10	a	X	c	d	e
11	a	b	c	d	X
12	a	b	c	d	X
13	a	X	c	d	e
14	X	b	c	d	e
15	a	b	c	d	X
16	a	b	c	d	X
17	a	b	c	d	X
18	a	b	c	X	e
19	a	X	c	d	e
20	a	X	c	d	e
21	a	b	c	X	e
22	a	b	c	d	X
23	X	b	c	d	e
24	a	b	c	X	e
25	a	b	X	d	e
26	a	X	c	d	e
27	a	b	c	d	X
28	a	b	c	d	e
29	a	b	c	X	e
30	a	b	c	d	e
31	a	b	c	d	e

29/31

(104/100)

IMAD

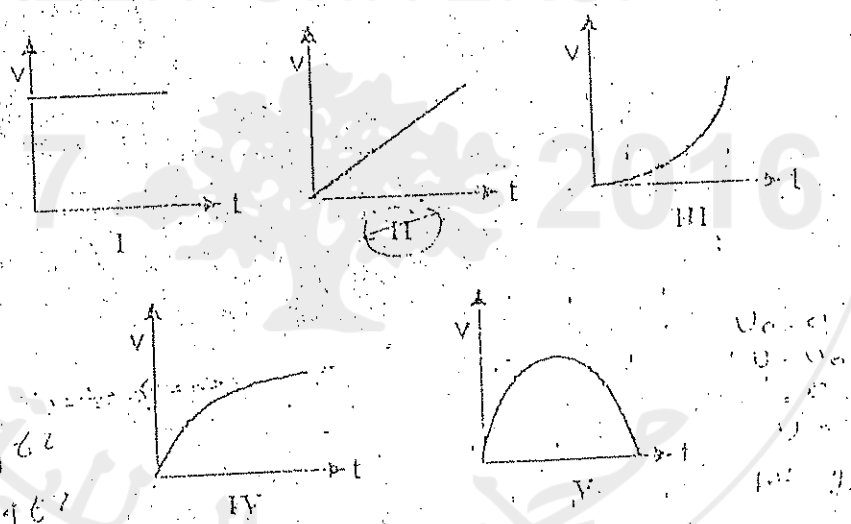
1. At time t = 0 a car has a velocity of 16 m/s. It slows down with an acceleration given by $a = -0.50t$, in m/s^2 for t in s. It stops at t =

a) 64 s
b) 32 s
c) 16 s
d) 8.0 s
e) 4.0 s

2. Two objects are thrown vertically upward. One with an initial velocity of 100 m/s and another object with an initial velocity of 10 m/s. The maximum height reached by the first object will be _____ that of the other.

a) 10 times
b) 100 times
c) 1000 times
d) 10,000 times
e) none of these

3. An object is dropped from rest. Which of the five following graphs correctly represents (يمثل) its motion?



a) I. b) II. c) III. d) IV. e) V.

4. Vectors A and B lie in the x-y plane. If ...

a) $A_x^2 + A_y^2 = B_x^2 + B_y^2$
b) $A_x + A_y = B_x + B_y$
c) $A_x = B_x$ and $A_y = B_y$
d) $A_y / A_x = B_y / B_x$
e) $A_x = A_y$ and $B_x = B_y$

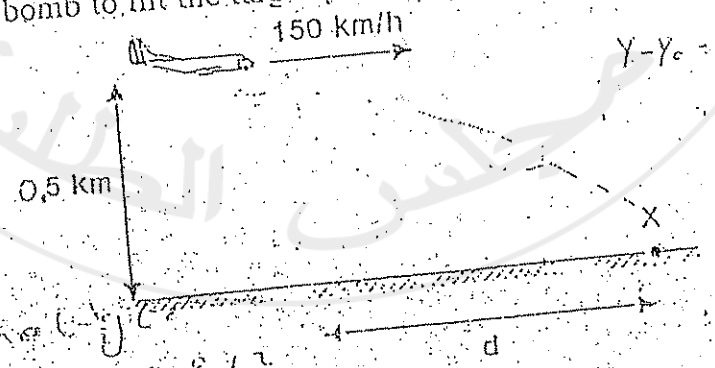
5. Let $\vec{A} = 2\hat{i} + 6\hat{j} - 3\hat{k}$ and $\vec{B} = 4\hat{i} + 2\hat{j} + \hat{k}$. Then $\vec{A} \cdot \vec{B}$ equals:

a) $8\hat{i} + 12\hat{j} - 3\hat{k}$
b) $12\hat{i} - 14\hat{j} - 20\hat{k}$
c) 23
d) 17
e) none of these

6. The value of $\hat{k} \cdot (\hat{k} \times \hat{i})$ is:

a) zero
b) +1
c) -1
d) 3
e) $\sqrt{3}$

7. The airplane shown is in level flight at an altitude of 0.50 km and a speed of 150 km/h. At what distance d should it release a heavy bomb to hit the target (لتصيب الهدف) X? Take g = 10 m/s^2.



a) 150 m b) 295 m c) 417 m d) 2550 m e) 15000 m

8. A stone is tied to the end of a string and is swung with constant speed around a horizontal circle with a radius of 1.5 m. If it makes two complete revolutions each second, its acceleration is:

a) 0.24 m/s^2
b) 2.4 m/s^2
c) 24 m/s^2
d) 240 m/s^2
e) 2400 m/s^2

9. A boat is able to move through still water at 20 m/s. It makes a round trip (ذهاب وإياب) to a town 3.0 km downstreamn (مع مسار النهر). If the river flows at 5 m/s, the time required for this round trip is:

a) 120 s
b) 150 s
c) 200 s
d) 300 s
e) 320 s

10. Two forces are applied to a 5.0-kg object, one is 6.0 N to the north and the other is 8.0 N to the west. The magnitude of the acceleration of the object is:

a) 0.50 m/s^2
b) 2.0 m/s^2
c) 2.8 m/s^2
d) 10 m/s^2
e) 50 m/s^2

A 1000-kg elevator is rising and its speed is increasing at 3 m/s^2. The tension in the elevator cable (حبل المصعد) is: (g = 9.8 m/s^2)

a) 6800 N
b) 1000 N
c) 3000 N
d) 9800 N
e) 12800 N

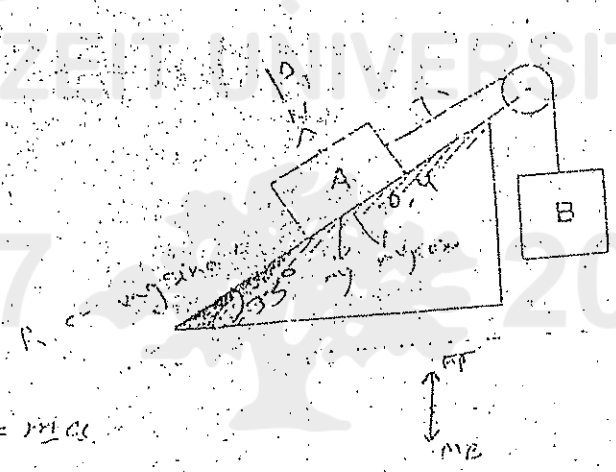
A lead block is suspended (علق) from your hand by a string. The pair of forces that include the force on the block is the force exerted by the:

a) string on the block
b) block on the string
c) string on the hand
d) hand on the string
e) block on the earth

13. A car is traveling at 88 ft/s on a horizontal road. The brakes are applied and the car skids (تنزلق) to a stop in 4.0 s. The coefficient of kinetic friction between the tires and road is:

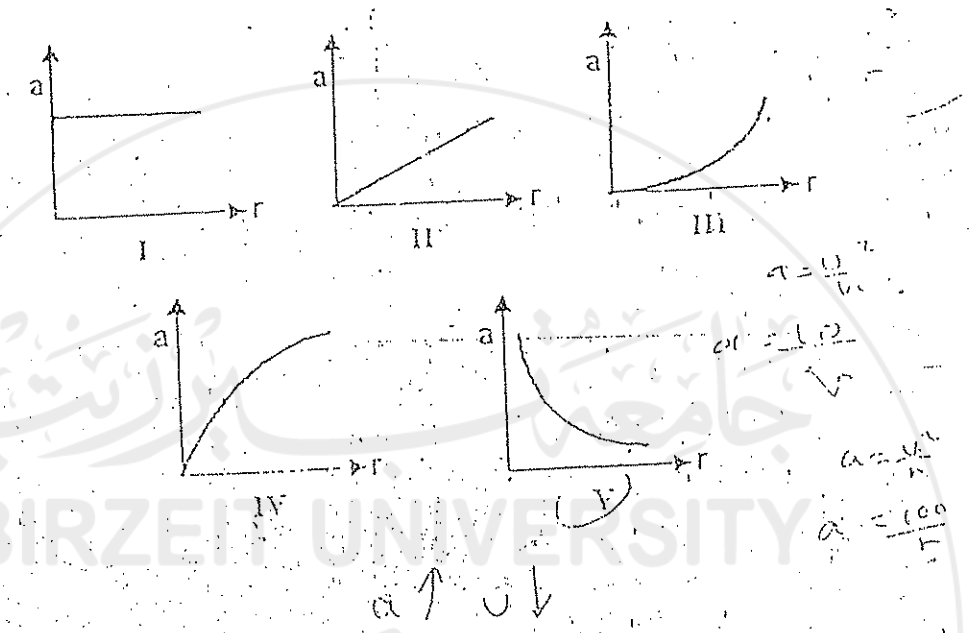
a) 0.48
b) 0.69
c) 0.77
d) 0.92
e) 1.11

14. Block A, with a mass of 10 kg, rests on a 35° incline. The coefficient of static friction is 0.40. An attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. The smallest mass m_B, attached to the dangling end (الطرف المتدلي), for which A remains at rest is:



a) 2.5 kg b) 3.5 kg c) 5.9 kg d) 9.0 kg e) 10.5 kg

15. Which of the following five graphs is correct for a particle moving in a circle of radius r at a constant speed of 10 m/s ?

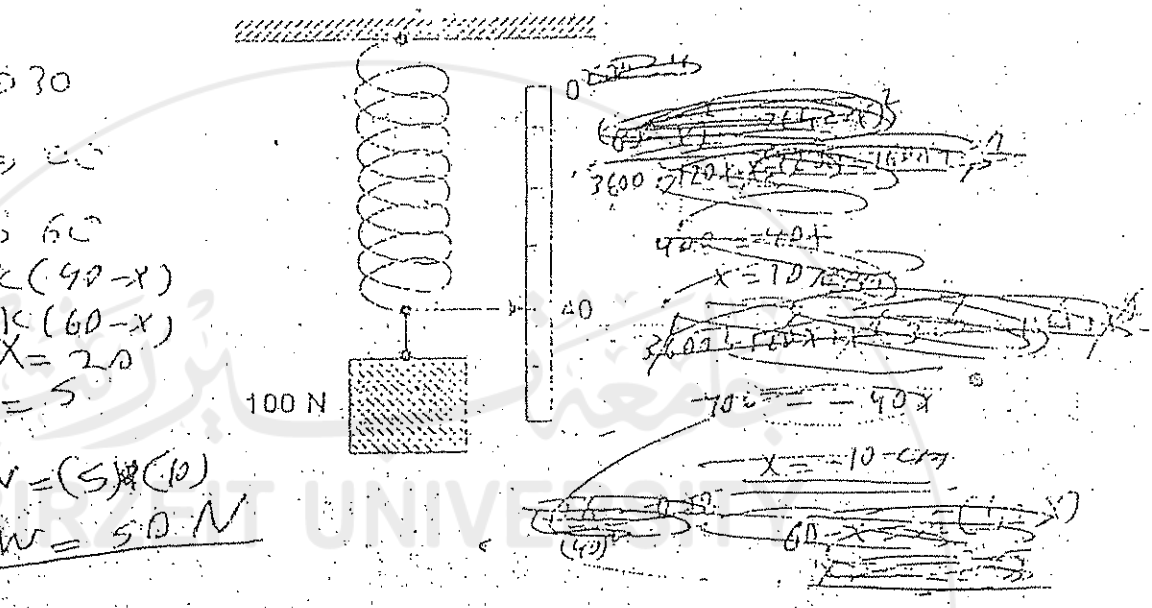


a) I. b) II. c) III. d) IV. e) V

16. The driver of a 1000-kg car tries to turn through a circle of radius 100 m on an unbanked curve at a speed of 10 m/s. The actual frictional force between the tires and slippery road is 900 N. The car will:

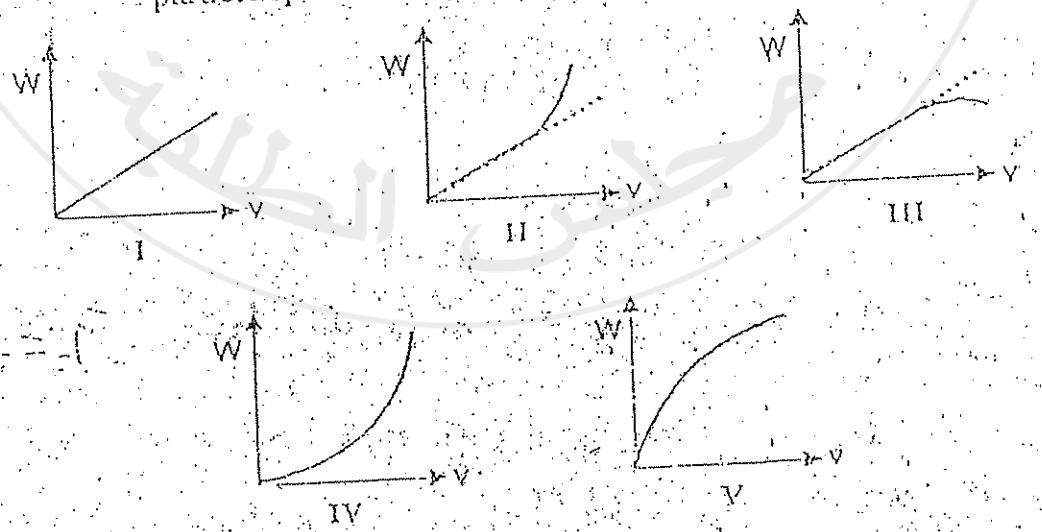
a) slide into the inside of the curve
b) make the turn
c) slow down due to the frictional force
d) make the turn only if it went faster
e) slide off to the outside of the curve

17. A spring, with a pointer attached to its end, hangs next to a scale. With a 100-N weight attached, the pointer indicates "40" on the scale as shown. Using a 200-N weight instead results in "60" on the scale. Using an unknown weight X instead results in "30" on the scale. The weight of X is:



a) 10 N b) 20 N c) 30 N d) 40 N e) 50 N

18. A particle is initially at rest on a horizontal frictionless table. It is acted upon by a constant horizontal force F. Which of the following five graphs is a correct plot of work W as a function of particle speed v?



a) I. b) II. c) III. d) IV. e) V.

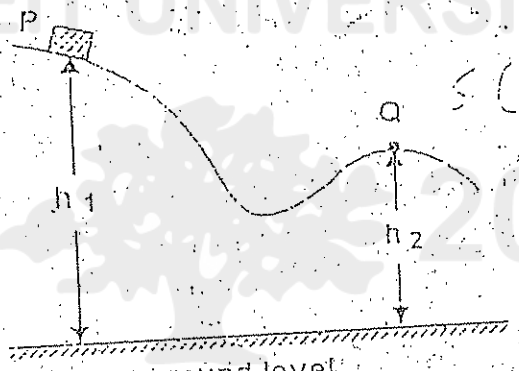
19. A 0.50-kg object moves on a horizontal frictionless circular track with a radius of 2.5 m. An external force of 3.0 N, always tangent to the track, causes the object to speed up as it goes around. If it starts from rest, then at the end of one revolution the radial component of the force of the track on it is:

a) 19 N b) 38 N c) 47 N d) 75 N e) 96 N

20. A 6.0-kg block is released from rest 80 m above the ground. When it has fallen 60 m its kinetic energy is:

a) 4800 J b) 3600 J c) 1200 J d) 120 J. e) 60 J.

21. A block at point P is released from rest and slides along the frictionless track shown. At point Q, its speed is:



$\frac{1}{2}mv^2 = mg h_1 - mg h_2$

$v^2 = 2g(h_1 - h_2)$.

a) $2g\sqrt{h_1 \cdot h_2}$
b) $2g(h_1 - h_2)$
c) $(h_1 - h_2)/2g$
d) $\sqrt{2g(h_1 - h_2)}$
e) $(h_1 - h_2)^2/2g$

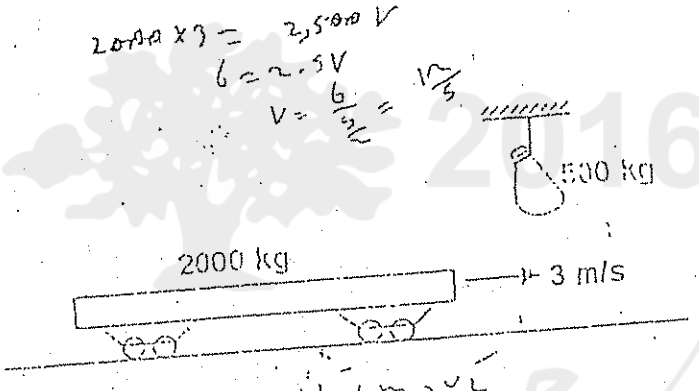
22. The potential energy of a body of mass m is given by $U = -mgx + 1/2\ kx^2$. The corresponding force is:

a) $-mgx^2/2 + kx^2/6$
b) $mgx^2/2 - kx^3/6$
c) $-mg + kx/2$
d) $-mg + kx$
e) $mg - kx$

23. The center of mass of a system of particles remains at the same place if:

a) it is initially at rest and the external forces sum to zero
b) it is initially at rest and the internal forces sum to zero
c) the sum of the external forces is less than the maximum force of static friction
d) no friction acts internally
e) none of the above

24. A 500 kg sack (كيس) of coal is dropped on a 2000 kg railroad flatcar which was initially moving at 3 m/s as shown. After the sack rests on the flatcar, the speed of the flatcar is:



a) 0.6 m/s b) 1.2 m/s c) 1.8 m/s d) 2.4 m/s e) 3.6 m/s

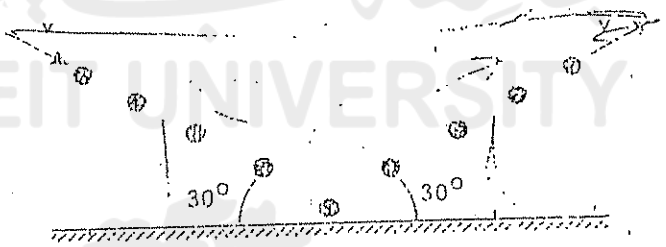
25. At one instant of time a rocket is traveling in outer space at 2500 m/s and is exhausting fuel at a rate of 100 kg/s. If the speed of the fuel as it leaves the rocket is 4500 m/s, relative to the rocket, the thrust is:

a) 0
b) 1.0×10^5 N
c) 1.5×10^5 N
d) 2.9×10^5 N
e) 2.5×10^5 N

26. A 3.00-gram bullet (رصاصة) traveling horizontally at 400 m/s hits a 3.00-kg wooden block which is initially at rest on a smooth horizontal table. The bullet buries itself in the block without passing through. The speed of the block after the collision is:

a) 133 cm/s
(b) 40 cm/s
c) 1200 cm/s
d) 4000 cm/s
e) 16000 cm/s

27. A stream of gas consists of n molecules. Each molecule has mass m and speed v. The stream is reflected elastically from a rigid surface as shown. The magnitude of the total change in momentum of the stream is:

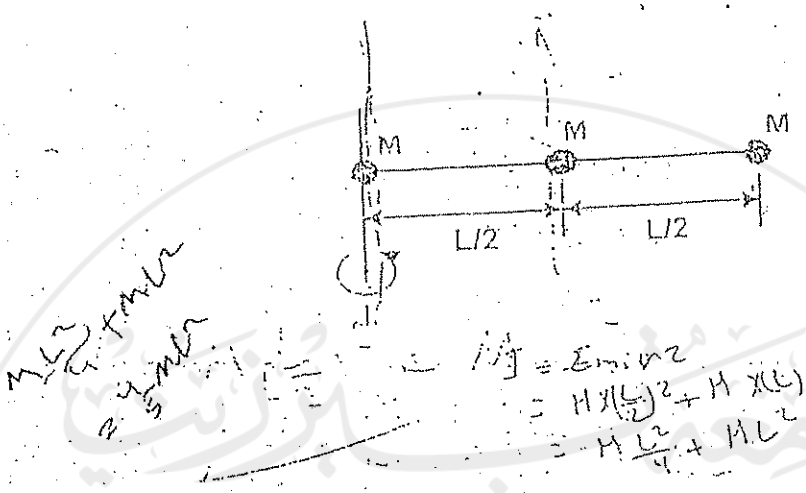


a) 2mnv
b) 2mnv sin 60°
c) mnv sin 60°
d) mnv cos 60°
e) mnv

28. A wheel starts from rest and has an angular acceleration that is given by $\alpha(t) = 6t^2$. The time it takes to make 10 revolutions is:

a) 2.8 s b) 3.4 s c) 4.0 s d) 4.7 s e) 5.3 s

29. Three identical (متماثلة) objects of mass M are fastened to a massless rod of length L as shown. The rotational inertia (moment of inertia) about one end of the rod of this array is:

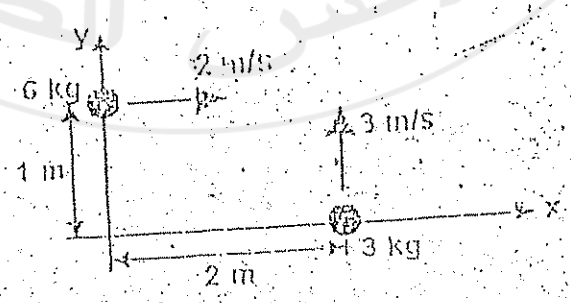


a) $ML^2/2$ b) ML^2 c) $3ML^2/2$ d) $5ML^2/4$ e) $3ML^2$

30. A disk with a rotational inertia of 5.0 kg. m^2 and a radius of 0.25 m rotates on a frictionless fixed axis perpendicular to the disk and through its center. A force of 2.0 N is applied tangentially to the rim (الحافة). The angular acceleration of the disk is:

a) 0.40 rad/s^2
b) 0.5 rad/s^2
c) 1.0 rad/s^2
d) 2.5 rad/s^2
e) 10 rad/s^2

31. Two objects are moving in the x-y plane as shown. The magnitude of their total angular momentum (about the origin O) is: (in kg. m^2/s)



a) zero b) 6 c) 12 d) 30 e) 78

GOOD LUCK

جامعة بيرزيت

BIRZEIT UNIVERSITY

Physics 141

Coordinator: TAYSEER AROURI

FINAL EXAM — **1st Sem. 2012/13**

TIME: 150 min — **15.1.2013**

Student Name: Lubna Shamasneh Student No.: 1120494

ضع إشارة (X) في كل من المربع المقابل لمدرس شعبتك ودائرة على رقم الشعبة.

	المدرس	الشعبة
☐	تيسير عاروري	4
☒	غسان أنضوني	1; 6; 12
☐	غاده حامد	9
☐	يعقوب عنيني	5; 13

	المدرس	الشعبة
☐	اسماعيل بدران	8, 14
☐	غسان عباس	10
☐	وفاء خاطر	7
☐	عبدالله سيد أحمد	2, 3, 11

Time : 2 pm

تعليمات:

1) لا تفتح ورقة الامتحان حتى يسمح لك بذلك.
2) اكتب اسمك ورقمك في أعلى هذه الصفحة.
3) اختر الجواب الأكثر قربا للجواب الصحيح وانقله على هذه الصفحة، وذلك بوضع إشارة (X) في الخانة المناسبة.
4) السؤال الذي له أكثر من إجابة يعطى علامة صفر.
5) يجب إعادة أوراق الامتحان كاملة.
6) عدد الأسئلة 32 سؤالاً.
7) $g = 10\ m/s^2$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A																
B	✓															
C															✓	
D				✓	✓		✓							✓		
E								✓								

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
A		✓														
B					✓		✓									
C						✓								✓		✓
D																
E																

1. In simple harmonic motion, the magnitude of the acceleration is:

A) inversely proportional to the displacement
B) proportional to the displacement
C) never greater than g
D) constant
E) greatest when the velocity is greatest

2. The coefficient of static friction between a certain cylinder and a horizontal floor is 0.40. If the rotational inertia of the cylinder about its symmetry axis is given by $I = (1/2)MR^2$, then the maximum acceleration the cylinder can have without slipping is:

$I = \frac{1}{2}MR^2$

A) 0.1 g
B) 0.2 g
C) 0.4 g
D) 0.8 g
E) g

3. A disk with a rotational inertia $I = 5.0\ kg.m^2$ and a radius of 0.25 m rotates on a frictionless fixed axis perpendicular to the disk and through its center. A force of 8.0 N is applied tangentially to the rim. The angular acceleration of the disk is:

Rotational inertia $I = 5.0\ kg.m^2$
Radius = 0.25 (m) $F = 8\ (N)$

$\alpha_{avg} = \frac{d\omega}{dt}$

A) 0.4 rad/s^2
B) 0.1 rad/s^2
C) 1.0 rad/s^2
D) 0.8 rad/s^2
E) 2.5 rad/s^2

4. An 800-kg elevator is descending and its speed is increasing at 4 m/s^2. The tension in the elevator cable is:

mass = 800 kg
$a = 4\ m/s^2$

A) 11200 N
B) 6500 N
C) 13500 N
D) 4800 N
E) 8000 N

$mg + T = ma$
$T + mg = ma$
$T + (800)(10) = (800)(4)$
$T + 8000 = 3200$
$T = 4800$

5. A car rounds a 80-m radius curve at a constant speed of 20 m/s. A ball is suspended by a string from the ceiling of the car and moves with the car. The angle between the string and the vertical is:

$V_{max} = \sqrt{Rg \tan\theta} \Rightarrow 400 = 800 \tan\theta$

$\theta = 26.6°$

A) 14.0°
B) cannot be found without knowing the mass of the ball
C) 53°
D) 26.6°
E) 36.3°

6. One object is thrown vertically upward with an initial velocity of 100 m/s and another object with an initial velocity of 10 m/s. The maximum height reached by the first object will be _____ that of the other.

$V_{i_a} = 100$ m/s $\quad V_{i_b} = 10$ m/s

A) 1000 times
B) 10 times
C) 10,000 times
D) none of these
E) 100 times

7. A rocket is traveling in outer space at 2500 m/s and is exhausting fuel at a rate of 80 kg/s. If the speed of the fuel as it leaves the rocket is 1500 m/s, relative to the rocket, the thrust is:

$\frac{dm}{dt} = 80$ kg/s $\quad V = 2500$ m/s $\quad V_{relative} = 1500$ m/s

A) 2.5×10^5 N
B) 1.5×10^5 N
C) 1.0×10^5 N
D) 1.2×10^5 N
E) 2.9×10^5 N

$Thrust = R\, V_{relative} \Rightarrow T = \frac{dM}{dt} V_{relative}$

$= (80)(1500) = 120000$ (N)

$= 1.2 \times 10^5$ (N)

$(V_{max} = \sqrt{Rg \tan\theta})^2$

$400 = 800 \tan\theta$

8. A 0.50-kg block attached to a spring with a spring constant of 100 N/m oscillates on a horizontal frictionless surface. The total mechanical energy is 4 J. The greatest extension of the spring from its equilibrium length is:

$E = 4\ J$ $\quad k = \frac{F}{x} = 100\ N/m$

A) 0.35 m
B) 0.48 m
C) 0.20 m
D) 0.12 m
E) 0.28 m

$E_{mechanical} = K + U$

$U = \frac{1}{2} k x^2$

$4 = \left(\frac{1}{2}\right)(100) x^2 \quad x^2 = 0.08 \Rightarrow x = 0.28\ (m)$

9. Suppose $A = B^n C^m$, where A has dimensions LT, B has dimensions L^2T^{-1}, and C has dimensions LT^2. Then the exponents n and m have the values:

A) 2/3; 1/3
B) 2; 3
C) 4/5; -1/5
D) 1/5; 3/5
E) 1/2; 1/2

10. A 400-kg stone is dropped in a 2000-kg truck which was initially moving at 5 m/s. After the stone rests on the truck, the speed of the truck is:

$(m_1 v_1 + m_2 v_2)_b = (m_1 v_1 + m_2 v_2)_a$

$(400)(0) + (2000)(5) = (400)$

A) 4.2 m/s
B) 5.6 m/s
C) 2.4 m/s
D) 3.6 m/s
E) 5.0 m/s

11. A 3.0-kg object moving in the positive x direction has a one-dimensional elastic collision with a 5.0-kg object initially at rest. After the collision the 5.0-kg object has a velocity of 9.0 m/s in the positive x direction. What was the initial speed of the 3.0 kg object?

A) 20 m/s
B) 12 m/s
C) 8.0 m/s
D) 16 m/s
E) 24 m/s

12. After flying for 15 minutes in a wind blowing 40 km/h at an angle 20° south of east, an airplane is over a town that is 60km due north of the starting point. The speed of the airplane relative to the air is:

A) 272 km/h , 14.5° West of North
B) 256.5 km/h , 8.5° West of North
C) 240 km/h, 20° South of East
D) 296 km/h , 19.5° North of West
E) 240 km/h , 17.5° West of North

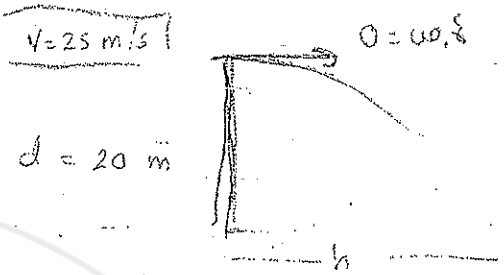
13. A projectile of mass 1.0 kg is fired with an initial speed of 10 m/s at an angle of 60° above the horizontal. The potential energy (relative to ground level) of the projectile at its highest point is:

$m = (1)$kg $\quad V_i = 10$ m/s $\quad$ angle $= 0 - 60$ ↑

A) 18.75 J
B) 75.0 J
C) 37.5 J
D) 50.0 J
E) 55.2 J

14. A boy on the top of a building 20 m high throws a stone horizontally outwards with a speed of 25 m/s. It strikes the ground at what horizontal distance from the building

A) 100 m
B) 45 m
C) 40 m
D) 50 m
E) 10 m



15. Starting at time t = 0, an object moves along a straight line. Its coordinate in meters is given by $x(t) = 96t - 2t^3$, where t is in seconds. When it momentarily stops its acceleration is:

A) -24 m/s^2
B) -10 m/s^2
C) 0
D) - 48 m/s^2
E) -30 m/s^2

16. A block is suspended from your hand by a string. The reaction to the force of gravity on the block is the force exerted by the:

A) string on the hand
B) hand on the string
C) block on the earth
D) string on the block
E) block on the string

17. A block rests on a rough horizontal surface ($\mu_s = 0.65, \mu_k = 0.40$). A constant horizontal force, just sufficient to start the block in motion , is applied. The acceleration of the block, in m/s^2, is:

A) 1.5
B) 0
C) 2.5
D) 3.5
E) 4.5

18. For the following three vectors:
$\mathbf{A} = 2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$
$\mathbf{B} = -3\mathbf{i} + 4\mathbf{j}$
$\mathbf{C} = 6\mathbf{i} - 5\mathbf{j}$
$\mathbf{C} \cdot (\mathbf{A} \times \mathbf{B}) =$

A) 36
B) 36 k
C) - 19
D) zero
E) 19

19. A ball of clay falls 15.0 m to the ground. It is in contact with the ground for 20.0 ms before stopping. The average acceleration of the ball during the time it is in contact with the ground is:

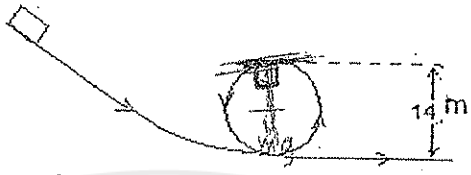
A) 866 m/s^2 Down
B) 1130 m/s^2 Up
C) 1130 m/s^2 Down
D) zero
E) 866 m/s^2 Up

$U_g = mgR$

20. A small object slides along the frictionless loop-the-loop with a diameter of 14 m. What minimum speed must it have at the top of the loop?

radius = 7 m

$mg + N = \frac{mv^2}{R}$



$mg = \frac{mv^2}{R} \Rightarrow (K+U)_i = (K+U)_f$

$\Rightarrow 0 + mgh = \frac{1}{2}mv^2 + mg\,2R$

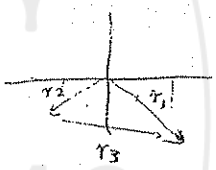
A) 11.8 m/s
B) 10.0 m/s
C) 4.2 m/s
D) 16.8 m/s
E) 8.4 m/s

21. A 2 kg particle moves with velocity components $v_x = 30$ m/s and $v_y = 60$ m/s as it passes through the point $P_1(3, -4, 0)$ m. Its angular momentum relative to point $P_2(-2, -2)$ m is:

$30\hat{i}$ $60\hat{j}$

$\vec{v} = 30\hat{i} + 60\hat{j}$ m/s

$\vec{r}_1 = (3\hat{i} - 4\hat{j})$ m



$\vec{l}_1 = \vec{r}_1 \times \vec{p}$

$= (3\hat{i} - 4\hat{j}) \times (60\hat{i} + 120\hat{j})$

A) 600 k kg.m^2/s
B) 720 k kg.m^2/s
C) 480 i kg.m^2/s
D) 960 k kg.m^2/s
E) 720 j kg.m^2/s

$\hat{i}$	$-\hat{j}$	$\hat{k}$
3	-4	0
60	120	0

22. The area under an acceleration-time graph represents:

A) acceleration
B) displacement
C) speed
D) change in velocity
E) change in acceleration

$\vec{r}_2 = (-2\hat{i} - 2\hat{j})$ m

$K(360+240)$

$600\ K$

$\vec{l}_2 = (-2\hat{i} - 2\hat{j}) \times (60\hat{i} + 120\hat{j})$

-2	-2	
60	120	$= -120$

$\vec{r}_1 = \vec{r}_2 + \vec{r}_3$ ..... (1)

$(3\hat{i} - 4\hat{j}) = (-2\hat{i} - 2\hat{j}) + \vec{r}_3 \Rightarrow \vec{r}_3 = (3\hat{i} - 4\hat{j}) - (-2\hat{i} - 2\hat{j})$

$5\hat{i} - 2\hat{j} = \vec{r}_3$

$\vec{l}_3 = \vec{r}_3 \times \vec{p} \Rightarrow (5\hat{i} - 2\hat{j}) \times (60\hat{j} + 120\hat{j})$

$\hat{i}$	$-\hat{j}$	$\hat{k}$
5	-2	0
60	120	0

$\Rightarrow$

$-\hat{i}$	$-\hat{j}$	$\hat{k}$
-2	-2	0
60	120	0

$-240 + 120$

$K(600+120) = 720\ K$

$= -120\ K$

23. The only force acting on a 4.0-kg body moving along the x axis is given by $F_x = (2-x)$ N, where x is in m. If the velocity of the object at x = 0 is +4 m/s, then its speed at x = 2.0 m is:

$W = \int F_x dx \Rightarrow W = \int 2x\, dx = \frac{2x^2}{2} = x^2$

$x^2 \Big|_0^2 \quad (2)^2 - (0)^2 = (4)\ J$

$W = \Delta K$

$4 = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \Rightarrow 4 = \frac{1}{2}(4)(v_f^2 - 16)$

A) 9.2 m/s
B) 4.2 m/s
C) 5.4 m/s
D) 3.6 m/s
E) 6.0 m/s

24. A wheel starts from rest and has an angular acceleration that is given by $\alpha(t) = 6t^2$. The time it takes to make 10 revolutions is:

$\omega_0 = 0$ $\quad \alpha(t) = 6t^2$ $\quad 10\ rev \Rightarrow 20\pi\ rad$

$\omega = \int \alpha\, dt$

$\omega = \int 6t^2\, dt \Rightarrow \omega = 2t^3 + C$

$4 = 2v_f^2 - \frac{3}{2}$ $\quad +\frac{3}{2}$

$\sqrt{v_f^2} = \sqrt{18}$

$v_f = 4.2\ m/s$

A) 2:14 s
B) 4.75 s
C) 3.35 s
D) 5.36 s
E) 4.0 s

25. A thin rod of length 1.2 m and mass 0.4 kg is suspended freely from its end at A. It was allowed to fall from a horizontal position. The speed of its end (B) when the rod is vertical is:
($I = 1/3\ ML^2$)

A ○——————— B

$l = 1.2\ m$

$m = 0.4\ kg$

A) 7.9 m/s
B) 12.0 m/s
C) 5.0 m/s
D) 6.0 m/s
E) 3.8 m/s

$\left(\frac{\omega - \omega_0}{\alpha}\right) = t$

26. A boat is sailing at 12 m/s 30° West of North with respect to the water in a river that is flowing at 6.0 m/s East. As observed from the shore, the boat is sailing:

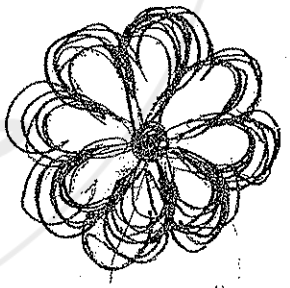
A) due West
B) 30° East of North
C) due North
D) none of these
E) 30° West of North

27. When a particle makes a head-on elastic collision with another particle, initially at rest, the greatest fraction of kinetic energy is transferred if:

A) the incident particle is much more massive than the target particle
B) the incident and target particle have the same mass
C) the incident particle is traveling very slowly
D) the incident particle is much less massive than the target particle
E) the incident particle is initially traveling very fast

28. A uniform disk has radius R and mass M. When it is rotating with angular velocity ω about an axis through its center and perpendicular to its face its angular momentum is Iω. When it is rotating with the same angular velocity about a parallel axis a distance h away its angular momentum is:

A) $(I + Mh^2)\omega$
B) $(I - MR^2)\omega$
C) $(I - Mh^2)\omega$
D) $(I + MR^2)\omega$
E) $I\omega$



29. An object of mass 40 g is moving in a horizontal circle of radius 0.5 m at a constant speed of 2 m/s. The work done on the object during one revolution is:

A) 2 J
B) 0 J
C) 5 J
D) 1 J
E) 4 J

30. At time t, $\vec{r} = 3t^2\,\hat{i} - t^3\,\hat{j}$ m, gives the position of a 2kg particle. The torque acting on the particle relative to the origin is:

A) $16\,t\,\hat{j}$ N.m
B) $24\,t^2\,\hat{j}$ N.m
C) $-24\,t^3\,\hat{k}$ N.m
D) $36\,t^3\,\hat{k}$ N.m
E) 0

31. A star of radius $R = 5 \times 10^5$ km makes one revolution every 60 hours. It collapses to form a nuetron star of radius r = 20 km. Its angular velocity becomes:
(moment of inertia for a solid sphere is $2MR^2/5$)

A) 1.93×10^3 rev / s
B) 2.31×10^2 rev / s
C) 1.16×10^4 rev / s
D) 4.86×10^5 rev / s
E) 2.89×10^3 rev / s

32. The potential energy of a 1.0 kg particle is given by:
$U(x) = 6/x^2 + 4/x \quad ; \quad x > 0$
If the total mechanical energy E = 16 J, then the turning point for the particle is:

A) 0.25 m
B) 1.5 m
C) 0.75 m
D) 0.5 m
E) 3.5 m