Brock University

Final Examination
Course: Physics 1P21/1P91
Date of Examination: December 9, 2011
Time of Examination: 14:00–17:00

Number of pages: 12
Number of Students: 184
Number of hours: 3
Instructor: M. Reedyk

Name	
Student ID	

No examination aids other than those specified on this examination script are permitted (FHB 5.1.2.A). Use or possession of unauthorized materials will automatically result in the award of a zero grade for this examination.

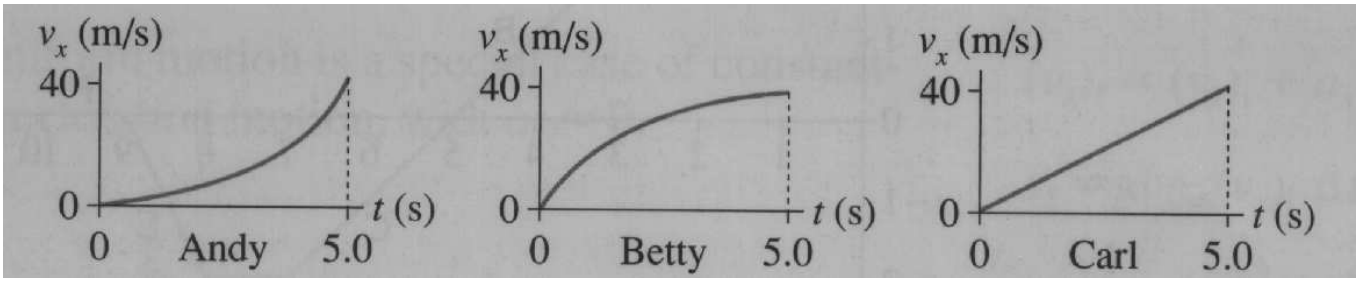
This is a closed–book test, only calculators are allowed
Formulas not on the supplied formula sheet must be derived

Attempt all problems
For multiple-choice questions 1–10 (and bonus), circle one of **a**–**d** on the **front page**

Question		Mark	Out of
1	a b c d		2
2	a b c d		2
3	a b c d		2
4	a b c d		2
5	a b c d		2
6	a b c d		2
7	a b c d		2
8	a b c d		2
9	a b c d		2
10	a b c d		2
Bonus	a b c d		2
11			10
12			10
13			10
14			10
15			10
16			10
17			10
18			10
Total			100

This exam contains 12 pages. Please, verify that your copy is complete.

(2) **1**. The velocity versus time graphs for three drag racers are shown below. Which car has travelled the furthest at $t = 5.0$ s?



a. All have travelled the same distance.
b. Andy.
c. Betty.
d. Carl.

(2) **2**. The velocity versus time graphs for three drag racers are shown above in Question 1. Which car had the greatest acceleration at $t = 0$?

a. Andy.
b. Betty.
c. Carl.
d. All had the same acceleration.

(2) **3**. Two balls, identical except for colour, are projected horizontally from the roof of a tall building at the same instant. The initial speed of the red ball is twice the initial speed of the blue ball. Ignoring air resistance,

a. the blue ball reaches the ground first.
b. the red ball reaches the ground first.
c. both balls land at the same instant with the same speed.
d. both balls land at the same instant with different speeds.

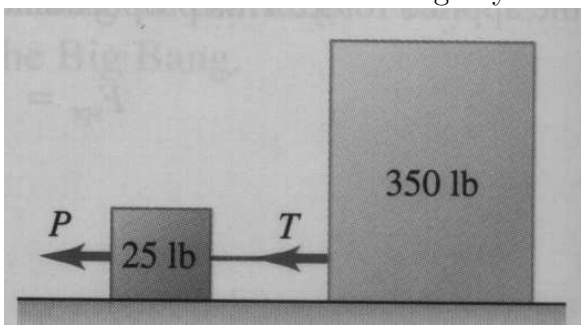
(2) **4**. Rachel is pushing a box across the floor while Jon, at the same time, is hoping to stop the box by pushing in the opposite direction. There is friction between the box and floor. If the box is moving at constant speed, then the magnitude of Rachel's pushing force is

a. Less than the magnitude of Jons force.
b. Greater than the magnitude of Jons force.
c. Equal to the magnitude of Jons force
d. The problem can't be answered without knowing how large the friction force is.

(2) **5**. Planet Z-43 has a mass equal to one-half that of Earth and a radius equal to one-half that of Earth. With g representing, as usual, the acceleration due to gravity on the surface of Earth, the acceleration due to gravity on the surface of Z-43 is:

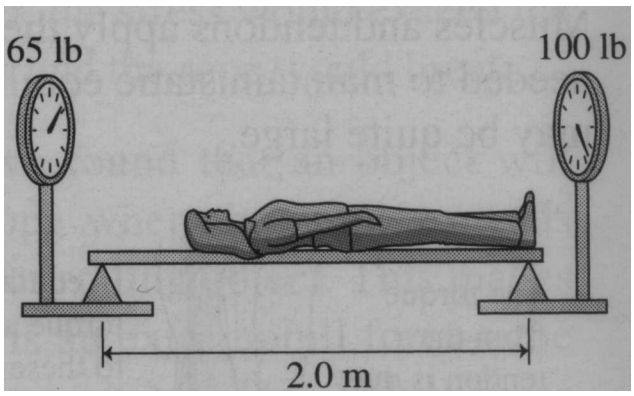
a. $2g$.
b. $g/2$.
c. $g/4$.
d. $4g$.

(2) **6**. A horizontal pull P drags two boxes of 25 lb and 350 lb connected by a horizontal rope having tension T as shown. The floor is horizontal and frictionless. Decide which of the following statements is true without doing any calculations:



a. We need more information to decide whether P or T is greater.
b. $P = T$ according to Newton's third law.
c. $P > T$.
d. $P < T$.

(2) **7**.



A student lies on a very light, rigid board with a scale under each end. Her feet are directly over one scale, and her body is positioned as shown in the figure. The two scales read the values shown in the figure. Approximately how far from her feet is her center of gravity?

a. 0.6 m
b. 0.8 m
c. 1.0 m
d. 1.2 m

(2) **8**. You and a friend each carry a 15 kg suitcase up two flights of stairs, walking at a constant speed. Take each suitcase to be the system. Suppose you carry your suitcase up the stairs in 30 s while your friend takes 60 s. Which of the following is true?

a. You did more work, but both of you expended the same power.

b. You did more work and expended more power.

c. Both of you did the same work, but you expended less power.

d. Both of you did the same work, but you expended more power.

(2) **9**. A 30 g, 3-cm-diameter solid sphere rotates at 20 rpm about a vertical, frictionless axis through its center. A 4 g bug stands at the top of the sphere. He then walks along the surface of the sphere until he reaches its equator. When he reaches the equator, the sphere is rotating at

a. 10 rpm

b. 15 rpm

c. 18 rpm

d. 20 rpm

(2) **10**. Suppose you travel to the moon, and you take with you two timepieces: a pendulum clock and a wristwatch that runs with a wheel and a mainspring. (The wheel and spring works, essentially, like a mass on a spring, but the wheel rotates back and forth rather than moving up and down.) Which will keep good time on the moon?

a. Neither timepiece

b. Both timepieces

c. Only the wristwatch

d. Only the pendulum clock

(2) **Bonus**. A space cowboy wants to eject from his spacecraft 1.30×10^5 km after passing a space buoy, as seen by spectators at rest with respect to the buoy. To do this, the cowboy sets a timer on his craft that will start as he passes the buoy. He plans to cruise by the buoy at 0.234 c. How much time should he allow between passing the buoy and ejecting?

a. 1.75 s

b. 1.80 s

c. 1.85 s

d. 1.90 s

(10) **11**. A speeding motorist zooms through a 50.0 km/h zone at 75 km/h, without noticing a stationary police car by the roadside. The police officer immediately heads after the speeder, accelerating at 2.5 m/s^2. When the officer pulls alongside the speeder

a. how far down the road are they, and

b. how fast is the police car going?

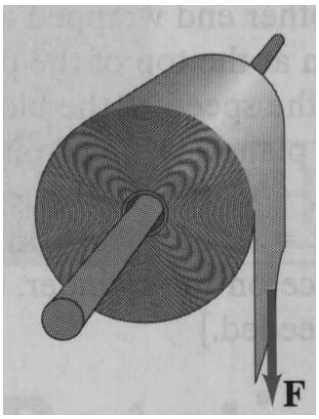
(10) **12**. A sea bird is flying at 18 m/s at an angle of 30.0^o below the horizontal when it accidentally drops a fish. If the bird is 16 m above the water when the fish drops,

a. what is the magnitude of the fish velocity when it hits the water, and

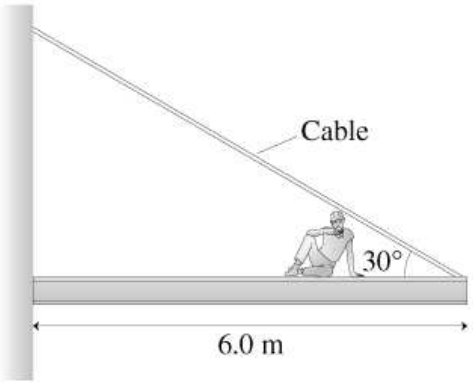
b. how long does it take the fish to fall.

(10) **13**. A 2.1 kg mass is connected to a spring of spring constant $k = 150$ N/m and unstretched length $L = 18$ cm. The pair are mounted on a frictionless air table, with the free end of the spring attached to a frictionless pivot. The mass is set into horizontal circular motion at 1.4 m/s. By how much, x, does the spring stretch? (Hint: find the radius, R, of the circular path first and note that $x = R - L$).

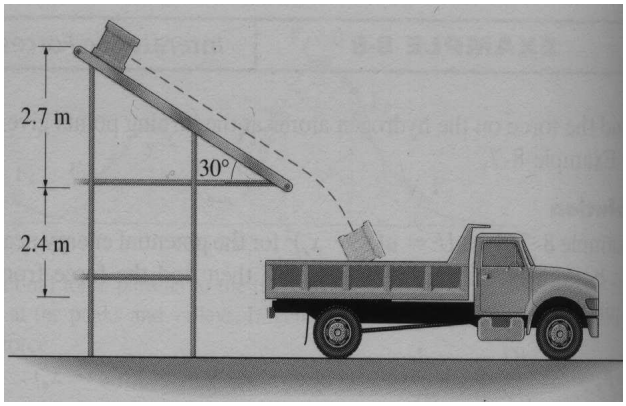
(10) **14**. The radius of the roll of paper shown is 7.5 cm and its moment of inertia is $I = 3.1 \times 10^{-3}$ kg m^2. A force of 3.2 N is exerted on the end of the roll for 1.3 s, but the paper does not tear so it begins to unroll. A constant friction torque of 0.11 N m is exerted on the roll which gradually brings it to a stop. Assuming that the paper's thickness is negligible, and that the moment of inertia remains the same as the paper unrolls, calculate the length of paper that unrolls during the time the force is applied.



(10) **15**. An 80.0 kg construction worker sits down 2.00 m from the end of a 1450 kg steel beam to eat his lunch, as shown below. Find the tension in the cable supporting the beam which is rated at 14,900 N. Is the worker in danger?



(10) **16**. At the end of a factory production line, boxes are placed on a 30.0^o ramp of height 2.7 m, as shown below. They slide down the ramp and drop into a waiting truck, whose bed lies 2.4 m below the end of the ramp. If a 10.0 kg box has kinetic energy 380 J when it lands in the truck, what is the coefficient of friction on the ramp?



(10) **17**. An 11000 kg freight car rests against a spring bumper at the end of a railroad track. The spring has constant $k = 3.2 \times 10^5$ N/m. The car is hit by a second car of 9400 kg moving at 8.5 m/s, and the two cars couple together.

a. What is the maximum compression of the spring?

b. What is the speed of the two coupled cars when they rebound from the spring?

(10) **18**. You rev your car's engine and watch the tachometer climb steadily from 1200 rpm to 5500 rpm in 2.7 s.

a. What is the angular acceleration of the engine?

b. What is the tangential acceleration of a point on the edge of the engine's 3.5 cm diameter crankshaft?

c. How many revolutions does the engine make during this time?