solutions

**Physics 1114**
**Midterm Makeup – Spring 2014**

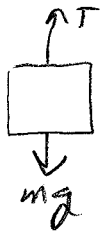
# Version A

Multiple choice (6 points each for questions 3-19)

1) Which exam version do you have?
   A) A
   B) B
   C) C
   D) D

2) What discussion section are you in?
   A) Section 11: 8:30-9:20 AM Physical Science Center 359 (Tang)
   B) Section 12: 10:30-11:20 AM Nielsen Hall Room 251 (Tang)
   C) Section 13: 11:30-12:20 PM Adams Hall Room 101 (Savoy)
   D) Section 14: 12:30-1:20 PM Physical Science Center 359 (Savoy)

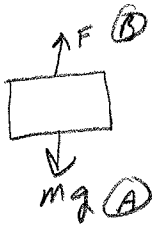
3) A 5 kg mass is hanging from a string. The mass is accelerating downward at a rate of 4.0 $m/s^2$. What is the tension in the string?
   a) 19 N
   b) 69 N
   c) 49 N
   (d) 29 N
   e) 0 N




↓+
$mg - T = ma$
$T = mg - ma$
$T = m(g-a)$
$T = 5kg(9.8 - 4.0) = 29N$

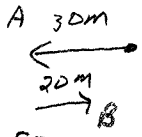
4) A mass sits at rest on top of a table. Which two forces that are not action-reaction pair forces are equal and opposite?
   A) The force of gravity on the mass due to the earth.
   B) The normal force on the mass due to the table.
   C) The force of gravity on the ~~earth~~ due to the mass.
   D) The force on the table due to the mass.
   a) A and C
   b) B and D
   c) A and D
   (d) A and B
   e) B and C

only 2 forces act on the mass



5) A dog walks 30 m from the origin toward the WEST to point A. It then walks from point A, 20 m more toward the EAST to point B. It took a total of 100 seconds for the entire trip. For the entire trip, what is the dog's average speed and what is the magnitude of the average velocity of the dog.

a) speed: 0.1 m/s velocity: 0.1 m/s
b) speed: 0.1 m/s velocity: 0.5 m/s
c) speed: 0.5 m/s velocity: 0.5 m/s
(d) speed: 0.5 m/s velocity: 0.1 m/s
e) speed: 0.3 m/s velocity: 0.2 m/s




Distance = 50 m
Displacement = 10 m

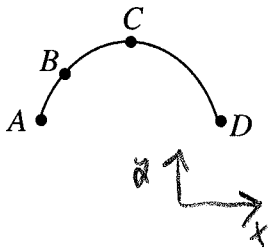
speed = $\frac{\text{distance}}{\text{time}} = \frac{50}{100}$

velocity = $\frac{\text{displacement}}{\text{time}} = \frac{10}{100}$

6) You hit a golf ball into the air and notice that the ball follows the parabolic path shown in the figure to the right. At which point on the path is the ball's velocity 0.

a) *A*
b) *B*
c) *C*
d) *D*
(e) None of the above

velocity always greater than 0 in X direction




7) The starship Enterprise is suddenly attacked by the Dominion battleship Founder-1. Initially, both ships are side-by-side and at rest. The Enterprise can accelerate at twice the rate as Founder-1. After a certain time, how much farther has the Enterprise traveled compared to Founder-1?

$x = x_0 + v_0 t + \frac{1}{2}at^2$ $\quad a_E = 2a_F$

$x = \frac{1}{2}at^2$ $\quad x_E = \frac{1}{2}2a_F t^2$

$x_F = \frac{1}{2}a_F t^2$ $\quad \frac{x_E}{x_F} = \frac{\frac{1}{2}2a_F t^2}{\frac{1}{2}a_F t^2} = 2$

a) $\sqrt{2}$ times farther.
(b) 2 times farther.
c) 4 times farther.
d) 6 times farther.
e) Can only be determined if we know the actual time and acceleration.

8) An object is thrown straight up into the air with a speed of 100 m/s. How long will be object be in the air before hitting the ground?

a. 10 s
b. 15 s
(c) 20 s
d. 25 s
e. 30 s


$v_0 = 100 m/s$

$v = v_0 - gt$ $\quad v = 0$ at top

$0 = v_0 - gt$

$t = \frac{v_0}{g} = 10.2s$

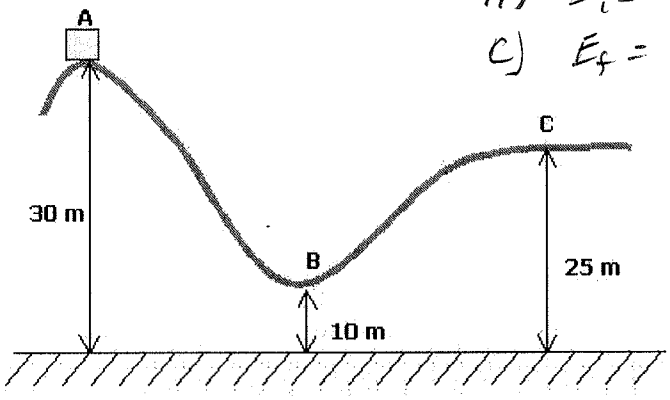
total time in air = $t_{up} + t_{down}$

$= 10.2 + 10.2 = 20.4s \approx 20s$

conservation of Energy

A) $E_i = \frac{1}{2}mv_i^2 + mgh_A$ $\quad E_i = E_f$

C) $E_f = \frac{1}{2}mv_f^2 + mgh_C$




$\frac{1}{2}mv_i^2 + mg(30m) = \frac{1}{2}mv_f^2 + mg(25m)$

$v_i^2 + 2g(30m) = v_f^2 + 2g(25m)$

$v_f^2 = v_i^2 + 2g(30m - 25m)$

$v_f^2 = (10m/s)^2 + 98m^2/s^2$

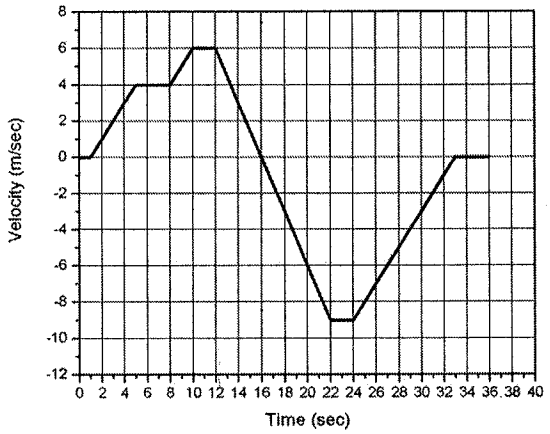
$v_f = 14.1\ m/s$

9) The above figure shows a frictionless roller coaster. The roller coaster car is traveling at 10 m/s to the right at point A. At what speed is the roller coaster car traveling at point C?

a. 20 m/s
b. 14 m/s
c. 10 m/s
d. 24 m/s
e. 6 m/s

10) The figure below shows the velocity as a function of time of a runner. What is the magnitude of the runner's instantaneous acceleration at 16 seconds?

a) 0 m/s$^2$
b) 1.5 m/s$^2$
c) 2.0 m/s$^2$
d) 2.5 m/s$^2$
e) 3.0 m/s$^2$




acceleration is slope of line

| v | t |
|---|---|
| 6 | 12.5 |
| -9 | 22.5 |

$a = \frac{\Delta v}{\Delta t} = \frac{15\ m/s}{10s} = 1.5\ m/s^2$

11) Two charged objects are attracted to each other by an electrostatic force. If the charge on each of the objects is doubled, the force between the objects

a. decreases by a factor of 1/4.
b. decreases by a factor of 1/2.
c. stays the same.
d. increases by a factor of 2.
e. increases by a factor of 4.

$F = \frac{K q_1 q_2}{r^2}$ double each charge

$F_1 = \frac{K(2q_1)(2q_2)}{r^2} = 4\frac{K q_1 q_2}{r^2} = 4F$

12) When a particle with a charge of 2.4 μC is traveling east at 2.9 x $10^3$ m/s, it encounters a magnetic field and feels a force of 8.3 x $10^{-3}$ N downward. What is the magnitude and direction of the magnetic field?

a. 1.2 T South
b. 1.2 T North
c. 12 T North
d. 1.2 x $10^{-6}$ T South
e. 1.2 x $10^{-6}$ T North

$F = qv_\perp B$ $B = \frac{F}{qv_\perp} = \frac{8.3\times10^{-3}\,N}{2.4\times10^{-6}\,C \cdot 2.9\times10^{3}\,m/s}$

$B = 1.2\,T$

F down ⊗ B south from RHR

13) Sphere A carries a net charge and sphere B is neutral. They are placed near each other on an insulated table. Which statement best describes the electrostatic force between them?

A) There is no force between them since one is neutral
B) There is a force of repulsion between them
C) There is a force of attraction between them
D) The force is attractive if A is charged positively and repulsive if A is charged negatively.
E) The force is repulsive is A is charge negatively and attractive if A is charged positively.

polarization causes attraction

14) In which instance is a car NOT accelerating:

a. The car is speeding up
b. The car is slowing down
c. The car is speeding up while turning.
d. The car is traveling at a constant speed while turning
e. The car is traveling at a constant speed in a straight line.

15) If the current flowing thorough a circuit of constant resistance is doubled, the power dissipated by that circuit will.

A) Quadruple
B) Double
C) Decrease to ½
D) Decrease to ¼
E) Stay the same

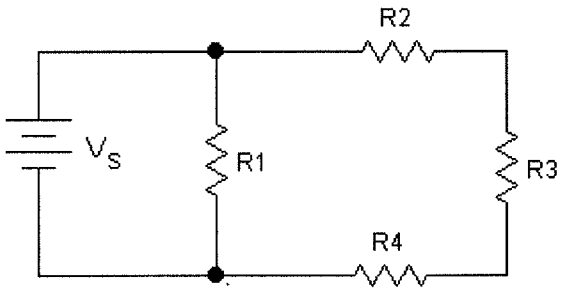
$P = I^2R$

if $I$ doubled

$P = (2I)^2R = 4I^2R$

16) A battery with an EMF of Vs is connected to 4 resistors as shown. What is the equivalent resistance of the 4 resistors if each resistor has a resistance of 2 ohms.

a. 1.5 ohms
b. 0.66 ohms
c. 2.0 ohms
d. 6.0 ohms
e. 8.0 ohms




First add $R_2, R_3$ & $R_4$ in series

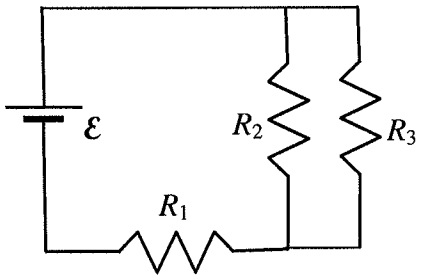
$2\Omega + 2\Omega + 2\Omega = 6\Omega$


add $2\Omega + 6\Omega$ in parallel

$\frac{1}{R_p} = \frac{1}{2\Omega} + \frac{1}{6\Omega} = \frac{3}{6\Omega} + \frac{1}{6\Omega} = \frac{4}{6\Omega}$

$R_p = \frac{6}{4}\Omega = 1.5\Omega$

17) In the circuit shown, the resistance $R_1$ is greater than $R_2$, and $R_2$ is greater than $R_3$. Rank the current through the three resistors from least to greatest, where the subscript on the current corresponds to the subscript on the resistor.




a. $I_1 < I_2 < I_3$
b. $I_1 < I_3 < I_2$
c. $I_3 < I_2 < I_1$
d. $I_3 < I_1 < I_2$
e. $I_2 < I_3 < I_1$

all current goes through $R_1$ so $I_1$ largest

resistors $R_2$ & $R_3$

one with smallest $R \rightarrow$ largest $I$

$V = IR$

V same across $R_2$ & $R_3$

$R_3$ smaller than $R_2$

so $I_3 > I_2$

$I_2 < I_3 < I_1$

18) A motorcycle traveling at 100 m/s hits the breaks and slows down at a rate of 4 $m/s^2$. How far has the motorcycle travelled 4 seconds after hitting the breaks?

a. 432 m
b. 368 m
c. 336 m
d. 400 m
e. 300 m

$x = \cancel{x_0}^{0} + v_0 t + \frac{1}{2} a t^2$

$x = (100\ m/s)(4s) + \frac{1}{2}(-4\ m/s)(4s)^2$

$x = 400\ m - 32\ m = 368\ m$

19) You are riding in a train that is traveling directly west at a constant velocity. Which of the following statements must be true about the forces acting on the train?

a. There is no net force acting on the train.
b. There are no forces acting on the train.
c. There are no forces on the train pointing east.
d. The net force acting on the train points to the west.
e. There are more forces acting on the train pointing west than forces pointing east.

$F_{net} = ma \quad a = 0$ so

$F_{net} = 0$