Review Problems

From

Chapters 1,2,3 and 4

Q1 An empty fuel tank of a car needs 50 liters of gasoline to fill up. Find the volume of the fuel tank in m**3. (1 milliliter = 1 cm**3)

A1 0.050
A2 50 000
A3 50
A4 500
A5 0.50

$1 \text{ liter} = 1000 \text{ mliter}$

$1\,\text{m}^3 = (100\ \text{cm})^3 = 10^6\,\text{cm}^3$

$$V = 50\,\text{liter} \times \frac{10^3\,\text{mliter}}{1\,\text{liter}} \times \frac{1\,\text{cm}^3}{1\,\text{mliter}} \times \frac{1\,\text{m}^3}{10^6\,\text{cm}^3} = 50 \times 10^{-3}\,\text{m}^3 = 0.050\,\text{m}^3$$

Q) Assuming that the time period of a simple pendulum, t, depends upon the length of the pendulum, l, and acceleration due to gravity, g, as:

$$t = k\, l^x g^y$$

where k is a dimensionless constant. The values of x and y are:

a) 1/2, -1/2

b) -1/2, 1/2

c) -1/2, -1/2

d) -1, -2

e) Can not be determined

$[t] = T, [k] = 1, [l] = L, [g] = LT^{-2}$

subsituting in the formula:

$[t] = [k][l]^x [g]^y$

$T = 1.L^x (LT^{-2})^y = L^x L^y T^{-2y} = L^{x+y} T^{-2y}$

equating the powers on both sides:

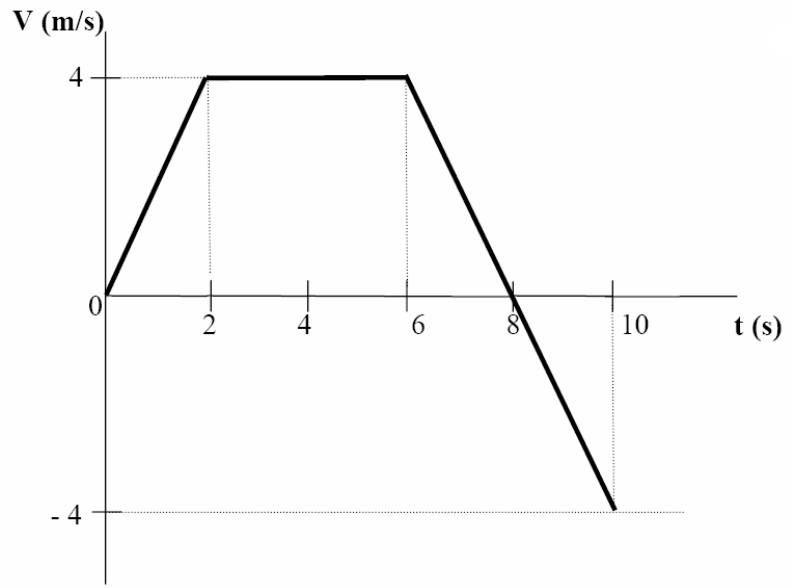
we get: $x + y = 0, -2y = 1$

y=-1/2

x=-y=1/2

Q2 How far does the runner whose velocity - time graph is shown in Fig. travel in 10 s?

A1 20 m
A2 24 m
A3 28 m
A4 32 m
A5 16 m



x = the area under the curve

$\frac{1}{2}(2\times 4)+(4\times 4)+\frac{1}{2}(2\times 4)-\frac{1}{2}(2\times 4)=4+16+4-4=20$ m

Q3 An object starts from rest at the origin and moves along the x-axis with a constant acceleration of 5.0 m/s**2. Find its average velocity as it goes from x = 0 m to x = 10 m.

A1 5.0 m/s
A2 10 m/s
A3 17 m/s
A4 3.0 m/s
A5 8.0 m/s

$$v_0 = 0,$$

$$v^2 = v_0^{\,2} + 2a(x - x_0)$$

$$v^2 = 0 + 2 \times 5.0 \times (10 - 0)$$

$$= 100$$

$$v = 10\ m/s$$

$$v_{avg} = \frac{v + v_0}{2} = \frac{10 + 0}{2} = 5.0\ m/s$$

Q4. Starting at time t = 0, an object moves along a straight line with a velocity in m/s given by v = 72 - 2 t**2, where t is in seconds. Find its acceleration when it stops momentarily.

A1 -24 m/s**2
A2 0
A3 -4.0 m/s**2
A4 -9.8 m/s**2
A5 -4.9 m/s**2

$$v = 0$$

$$0 = 72 - 2t^2,$$

$$t = 6\ s,$$

$$a = \frac{dv}{dt} = 0 - 4t = -4 \times 6 = -24\ m/s^2$$

Q5 A stone is thrown vertically upward with an initial speed of 15 m/s. What is its speed at a height of 10 m from its release point?

A1 5.4 m/s
A2 0
A3 It will not reach the height of 10 m.
A4 9.8 m/s
A5 12 m/s

$$v_0 = 15\ m/s$$

$$we\ take\ y_0 = 0$$

$$y = 10\ m$$

$$a = -9.8\ m/s^2$$

$$v^2 = v_0^2 + 2a(y - y_0)$$

$$v^2 = 225 - 2 \times 9.8 \times 10$$

$$v^2 = 29$$

$$v = 5.4\ m/s$$

Q6 For the following three vectors;
A=2i+3j+4k, B=4i+4j and C= 2i+2k, find A.(BxA).

A1 0
A2 -16i+16j-8k
A3 16i-16j+8k
A4 8i- 8j-8k
A5 -8i+ 8j+8k

$$\vec{A}.(\vec{B}\times\vec{A})=0$$

because $(\vec{B}\times\vec{A})\perp\vec{A}$

Q7 A plane traveling north at 200 m/s turns and then travels south at 200 m/s. The change in its velocity is:

A1 400 m/s South
A2 400 m/s North
A3 200 m/s North
A4 200 m/s South
A5 0 m/s

$v_1 = 200$ j

$v_2 = -200$ j

$\Delta v = v_2 - v_1 = (-200j - 200j) = -400j$

hence the change in the velocity is

400 m/s south

Q8 At t=0, a particle moving in the xy plane with a constant acceleration of a=(2i + 4j) m/s**2 has a velocity Vo=(-4j) m/s at the origin. Find the speed of the particle at t=3 s.

A1 10 m/s
A2 0
A3 4 m/s
A4 24 m/s
A5 20 m/s

on the $x-$*axis*:

$v_0 = 0\ m/s$

$a = 2\ m/s^2$

$at\ t = 3; v = v_0 + at = 0 + 2 \times 3 = 6\ m/s$

on the $y-$*axis*:

$v_0 = -4\ m/s$

$a = 4\ m/s^2$

$at\ t = 3; v = v_0 + at = -4 + 4 \times 3 = 8\ m/s$

$$hence \quad v = \sqrt{36 + 64} = \sqrt{100} = 10\ m/s$$

Q9 A ball is projected from the ground into the air with velocity Vo. At a height of 10.0 m the velocity is observed to be V = 8.5 i + 9.1 j in m/s. Find Vo.

A1 (8.5 i + 16.7 j) m/s
A2 (16.7 i + 9.1 j) m/s
A3 (8.5 i + 9.1 j) m/s
A4 (2.5 i + 3.1 j) m/s
A5 (6.2 i + 1.1 j) m/s

$on\ the\ x-axis:$

$v_0 = 8.5\ m/s$

$on\ the\ y-axis:$

$y = 10.0\ m;\ v = 9.1\ m/s,\ a = -9.8\ m/s^2,$

$v^2 = v_0{}^2 + 2ay,$

$9.1^2 = v_0{}^2 - 2\times 9.8\times 10.0,$

$v_0 = 16.7\ m/s$

$hence\quad v_0 = 8.5i + 16.7\ j$

Q10 A particle moves at a constant speed in a circular path with a radius of 2.0 cm. If the particle makes 4 revolutions each second, what is the magnitude of its acceleration?

A1 13 m/s**2
A2 20 m/s**2
A3 15 m/s**2
A4 18 m/s**2
A5 24 m/s**2

$$R = 0.02\,m,$$

$$T = 1/4 = 0.25\,s$$

$$v = \frac{2\pi R}{T} == 0.50\,m/s,$$

$$a = \frac{v^2}{R} = 12.6\,m/s^2 \approx 13\,m/s^2$$

Q11 The pilot of an airplane flies due north relative to the ground with a speed of 80 km/h. A wind is blowing towards the east with a speed of 40 km/h. What is the speed of the airplane relative to the wind?

A1 89 km/h
A2 85 km/h
A3 81 km/h
A4 76 km/h
A5 72 km/h

$$v_{AG} = (80\ km/h)\ j$$

$$v_{WG} = (40\ km/h)\ i$$

$$v_{AW} = v_{AG} + v_{GW} = v_{AG} - v_{WG} = (40\ i - 80\ j)\ km/h,$$

$$\left|v_{AW}\right| = \sqrt{1600 + 6400} = 89\ km/h$$