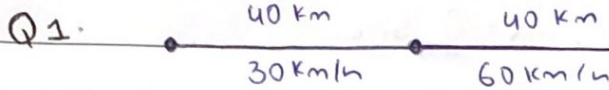


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Assignment 2



a) average velocity

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

$$30 = \frac{40}{t}$$

$$t = \frac{4}{3} \text{ hr.}$$

$$60 = \frac{40}{t}$$

$$t = \frac{4}{6} \text{ hr}$$

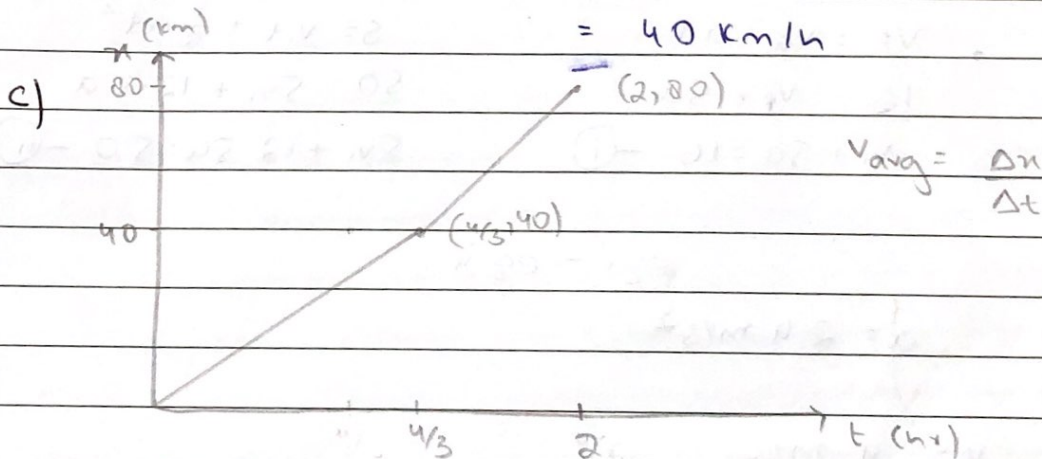
$$\text{average velocity} = \frac{\text{total displacement}}{\text{total time}}$$

$$= \frac{80}{\frac{4}{3} + \frac{4}{6}} = 40 \text{ km/h}$$

b) average speed

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$= 40 \text{ km/h}$$



Q2. $v_i = 0$ $v_f = 25 \text{ m/s}$, $t = 8 \text{ sec}$

a) $a = \frac{\Delta v}{\Delta t} = \frac{25-0}{8} = 3.1 \text{ m/s}^2$

b) $v = \frac{s}{t}$; $25 = \frac{s}{8} = 200 \text{ m}$

Q3. at t , speed = 18 m/s in +ve direction
after 2.4 s , speed = 30 m/s in -ve direction

$a = \frac{\Delta v}{\Delta t} = \frac{-30-18}{2.4} = -20 \text{ m/s}^2$

Q4. constant acceleration

a)	$v_f = v_i + at$	$s = vit + \frac{1}{2}at^2$
	$16 = v_i + 5a$	$50 = 5v_i + 12.5a$
	$v_i + 5a = 16$ — (i)	$5v_i + 12.5a = 50$ — (ii)

eq i = eq ii

$a = 2.4 \text{ m/s}^2$

b) $v = 4 \text{ m/s}$

Q5. $x = 3t - 4t^2 + t^3$

a) $t = 1$, ~~$x = 0$ m~~

$$x = 3(1) - 4(1)^2 + (1)^3$$

$$x = 0 \text{ m}$$

b) $t = 2$

$$x = 3(2) - 4(2)^2 + (2)^3$$

$$x = -2 \text{ m}$$

c) $t = 3$

$$x = 3(3) - 4(3)^2 + (3)^3$$

$$x = 0 \text{ m}$$

d) $t = 4$

$$x = 3(4) - 4(4)^2 + (4)^3$$

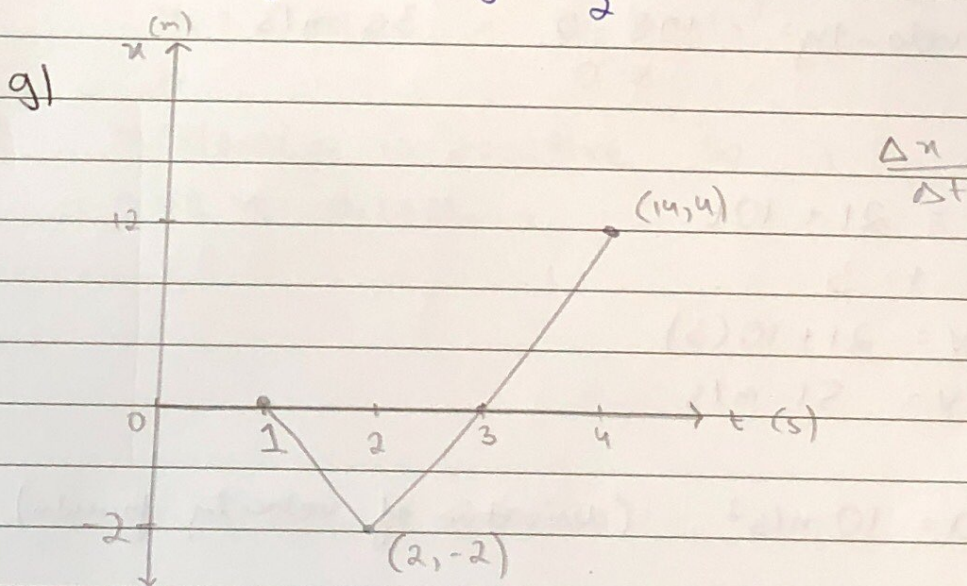
$$x = 12 \text{ m}$$

e) displacement = 12 m

f) total displacement = 14 m $(12 - (-2))$

total time = $4 - 2 = 2 \text{ s}$

average velocity = $\frac{14}{2} = 7 \text{ m/s}$



Q6. $x = 21t + 5t^2$

a) at $t = 0$, at $t = 3$
 $x = 0$ $x = 21(3) + 5(3)^2$
 $x = 108 \text{ m}$

avg. velocity = $\frac{108 - 0}{3 - 0} = 36 \text{ m/s}$

b) $v = 21 + 10t$
at $t = 3$
 $v = 21 + 10(3)$
 $v = 51 \text{ m/s}$

c) $a = 10 \text{ m/s}^2$ (derivative of velocity formula)

Q7. $x_0 = -2 \text{ m}$

a) $x - x_0 = v_0 t + \frac{1}{2} a t^2$

at $t = 1$, $x = 0 \text{ m}$

$\Rightarrow 2 = v_0 + \frac{1}{2} a$ — (i)

at $t = 2$, $x = 6 \text{ m}$

$\Rightarrow (6 + 2) = 2v_0 + 2a$

$8 = 2v_0 + 2a$

$4 = v_0 + a$ — (ii)

(i) = (ii)

$v_0 = 0 \text{ m/s}$

$a = 4 \text{ m/s}^2$

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b) acceleration is positive so it is in +ve x direction.

Q8. radius = 5 m , angular speed = 12 rad/s,

$$t = 0, 1.5 \text{ m}$$

a)

$$x = A \cos(\omega t + \phi)$$

$$x = 5 \cos(12t + \phi)$$

$$\text{at } t = 0 \quad x = 1.5$$

$$1.5 = 5 \cos \phi$$

$$\phi = 1.266 \text{ rad}$$

$$x = 5 \cos(12t + 1.266)$$

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$$v = -5 \sin(12t + 1.266) \times 12$$

$$v = -60 \sin(12t + 1.266)$$

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$$a = -60 \cos(12t + 1.266) \times 12$$

$$a = -720 \cos(12t + 1.266)$$

Q9. Average velocity

$$V_{\text{avg}} = \frac{(-2-5)\hat{i} + (8+6)\hat{j} + (-2-2)\hat{k}}{10}$$

$$= (-0.7\hat{i} + 1.4\hat{j} - 0.4\hat{k}) \text{ m/s}$$

Q10. a) at $t = 2$

$$\vec{r} = (2(2)^3 - 5(2))\hat{i} + (6 - 7(2)^4)\hat{j}$$

$$\vec{r} = 6\hat{i} - 106\hat{j}$$

$$b) \frac{d\vec{r}}{dt} = \vec{v} = (6t^2 - 5)\hat{i} + (-28t^3)\hat{j}$$

$$\text{at } t = 2$$

$$\vec{v} = (6(2)^2 - 5)\hat{i} + (-28(2)^3)\hat{j}$$

$$\vec{v} = 19\hat{i} - 224\hat{j}$$

$$10. c) a = \frac{dv}{dt} = (12t)\hat{i} + (-84t^2)\hat{j}$$

$$\text{at } t = 2$$

$$a = (12(2))\hat{i} + (-84(2)^2)\hat{j}$$

$$\vec{a} = 24\hat{i} - 336\hat{j}$$

$$d) \tan \theta = \frac{v_y}{v_x} = \frac{-224}{19} = -85.2^\circ \quad \text{or } 84.8^\circ$$

it is in 4th quadrant

$$Q11. \text{ height} = 9.1 \text{ m}, \quad \vec{v} = 7.6\hat{i} + 6.1\hat{j}$$

$$a) \quad 2as = v_f^2 - v_{0y}^2$$

$$2(-9.81)(9.1) =$$

$$2gs = v_f^2 - v_{iy}^2$$

$$2(-9.81)(9.1) = 0 - v_{iy}^2$$

$$v_{iy} = 14.7 \text{ m/s}$$

$$\text{at max height, } v_f = 0$$

$$2gs = v_f^2 - v_{iy}^2$$

$$2(-9.81)s = 0 - (14.7)^2$$

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$$\text{max height} = 11 \text{ m}$$

$$b) \quad R = \frac{2v_{0x}v_{0y}}{g}$$

$$= \frac{2(7.6)(14.7)}{(9.8)}$$

$$= 23 \text{ m}$$

Q11. c) $V_{ix} = 7.6 \text{ m/s}$ $V_{iy} = 14.7 \text{ m/s}$

$$|v| = \sqrt{7.6^2 + (14.7)^2}$$
$$= 17 \text{ m/s}$$

d) $\tan \theta = \frac{14.7}{7.6}$

$$\theta = -63^\circ \quad (4^{\text{th}} \text{ Quad})$$

Q12.

radius = 3 m $\vec{a} = (6 \text{ m/s}^2)\hat{i} + (-4 \text{ m/s}^2)\hat{j}$

$$\vec{v} \cdot \vec{a} = va \cos \theta$$

velocity and acceleration are perpendicular
so $\theta = 90^\circ$ and $\cos 90^\circ = 0$

$$\vec{v} \cdot \vec{a} = 0$$