1-D Kinematics ~~Review~~ Practice Name: Solutions

1. Match each of the variables to their description

A. v	__G__ Acceleration
B: Δ	__C__ Average velocity
C: $\bar{v}$	__B__ Change in
D: v_0	__F__ Displacement
E: v_f	__E__ Final Velocity
F: d	__D__ Initial Velocity
G: a	__H__ Time
H: t	__A__ Velocity

2. Match each of the variables to their description

A. Distance	__D__ Change in displacement divided by change in time.
B: Displacement	__C__ Change in distance divided by change in time.
C: Speed	__E__ Change in velocity divided by change in time.
D: Velocity	__B__ How far from where it started something has ended up.
E: Acceleration	__A__ How far something has travelled.

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3. The average velocity of a train is 45 m/s. How far does it go in 32 seconds?

*Use formula $d = \bar{v}t$

$\bar{v} = 45 m/s$ $t = 32 sec$

$d = \left(\frac{45m}{s}\right)(32s)$

$= 1440m \approx 1400m$

4. The final velocity of a ball rolling down a ramp is 16 m/s, the initial velocity was 0 and it accelerated at 0.67 m/s^2. How long did it roll for?

*Use formula $v_f = v_0 + at$

$v_f = 16 m/s$
$v_0 = 0$
$a = 0.67 m/s^2$

$t = \frac{v_f - v_0}{a}$

$t = \frac{16 \frac{m}{s} - 0}{0.67 \frac{m}{s^2}} = 24 sec$

5. A car initially at rest accelerates at 2.52 m/s^2. How long will it take the car to travel 560 m?

*Use formula $d = v_0 t + \frac{1}{2}at^2$

$a = 2.52 m/s^2$ $d = 560m$

$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(560m)}{2.54 m/s^2}}$

$= 20.998...$

$\approx 21 sec$

6. What is the acceleration of an object which was initially moving at 26 m/s and travels 250 m in 25 seconds?

*Use formula $d = v_0 t + \frac{1}{2}at^2$

$v_0 = 26 m/s$
$d = 250m$
$t = 25 sec$

$a = \frac{2(d - v_0 t)}{t^2}$

$a = \frac{2(250m - 26\frac{m}{s}(25s))}{25 sec^2}$

$= -1.28 m/s^2 \approx -1.3 m/s^2$

7. What is the average velocity of a car that starts at 5.8 m/s and accelerates at a constant rate to 23.5 m/s?

*Use formula $\bar{v} = \frac{v_0 + v_f}{2}$

$v_0 = 5.8 m/s$
$v_f = 23.5 m/s$

$\bar{v} = \frac{v_0 + v_f}{2}$

$= \frac{5.8\frac{m}{s} + 23.5\frac{m}{s}}{2}$

$= 14.65 m/s$

$\approx 15 m/s$

8. What is the acceleration of car if it travels 250 m while it slows from 25m/s to 15 m/s?

*Use formula $v_f^2 = v_0^2 + 2ad$

$v_0 = 25 m/s$
$v_f = 15 m/s$
$d = 250m$

$a = \frac{v_f^2 - v_0^2}{2d}$

$a = \frac{15\frac{m}{s}^2 - \left(25\frac{m}{s}\right)^2}{2(250m)}$

$= -0.80 m/s^2$

9. Match each formula to its description

A. $\bar{v} = \frac{\Delta d}{\Delta t}$	__E__ Acceleration is change in velocity divided by change in time
B: $d = \bar{v}t$	__F__ Average velocity is the average of final and initial velocity
C: $v_f = v_0 + at$	__B__ Displacement is average velocity multiplied by time.
D: $d = v_0 t + \frac{1}{2}at^2$	__C__ Final velocity is the starting velocity plus the acceleration times how long it has been accelerating.
E: $a = \frac{\Delta v}{\Delta t}$	__D__ If acceleration is constant then the displacement of the object will be its starting velocity multiplied by time plus half of the acceleration multiplied by the time it has been accelerating squared
F: $\bar{v} = \frac{v_f + v_0}{2}$	__G__ The square of final velocity is equal to the square of initial velocity plus twice the acceleration multiplied by the displacement.
G: $v_f^2 = v_0^2 + 2ad$	__A__ Average velocity is change in displacement divided by change in time.

10. Choose the formula you would use to solve.

A: $v_f = v_0 + at$	__C__ You know **change in velocity**, and **change in time.** You want to find **acceleration**.
B: $d = v_0 t + \frac{1}{2}at^2$	__E__ You know **initial velocity**, **acceleration**, and **displacement**. You want to find **final velocity**.
C: $a = \frac{\Delta v}{\Delta t}$	__A__ You know **initial velocity**, **acceleration**, and **time**. You want to find **final velocity**.
D: $\bar{v} = \frac{v_f + v_0}{2}$	__D__ You know **initial velocity**, and **final velocity**. You want to find **average velocity**.
E: $v_f^2 = v_0^2 + 2ad$	__B__ You know **initial velocity**, **time**, and **acceleration**. You want to find **displacement**.

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11. Choose the formula you would use a rearranged version of to solve

A. $v = \frac{\Delta d}{\Delta t}$	__C__ You know **acceleration, initial velocity**, and **final velocity.** You want to find **time.**
B: $d = \bar{v}t$	__F__ You know **average velocity** and **initial velocity**. You want to find **final velocity**.
C: $v_f = v_0 + at$	__E__ You know **change in velocity**, and **acceleration.** You want to find **change in time**.
D: $d = v_0 t + \frac{1}{2}at^2$	__B__ You know **displacement** and **time**. You want to find **average velocity**.
E: $a = \frac{\Delta v}{\Delta t}$	__D__ You know **displacement, initial velocity,** and **time.** You want to find **acceleration.**
F: $\bar{v} = \frac{v_f + v_0}{2}$	__G__ You know **final velocity, initial velocity,** and **displacement.** You want to find **acceleration.**
G: $v_f^2 = v_0^2 + 2ad$	__A__ You know **velocity**, and **change in displacement.** You want to find **change in time.**

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12. A car travelling at 45 m/s hits the breaks causing it to accelerate at -9.2 m/s², how far will it travel in the next 2.0 seconds? What we have: $V_0 = 45 m/s$ $a = -9.2 m/s^2$ $t = 2.0 sec$ What we want: d Formula: $d = v_0 t + \frac{1}{2} a t^2$ Answer: $71.6 m \approx 72 m$	13. A car drives at a constant velocity of 24 m/s for 650 metres. How long does it take? What we have: $\bar{v} = 24 m/s$ $d = 650 m$ What we want: t Formula: $d = \bar{v} t$ Answer: $27.08 sec \approx 27 sec$
14. An car travelling at 45 m/s hits the breaks causing it to accelerate at -9.2 m/s², how far will it travel before it stops? What we have: $V_0 = 45 m/s$ $a = -9.2 m/s^2$ $V_f = 0 m/s$ What we want: d Formula: $V_f^2 = V_0^2 + 2ad$ Answer: $110.05 m$ $\approx 110 m$	15. A car slows to a stop from 29 m/s in 2.5 seconds. What was the acceleration of the car? What we have: $V_0 = 29 m/s$ $V_f = 0 m/s$ $t = 2.5 sec$ What we want: a Formula: $V_f = V_0 + at$ Answer: $-11.6 m/s^2$ $\approx -12 m/s^2$

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16. What is the final velocity of a car which starts at 34 m/s and accelerates at $-3.4\ \mathrm{m/s^2}$ over a distance of 65m? What we have: $v_0 = 34 m/s$ $a = -3.4 m/s^2$ $d = 65m$ What we want: v_f Formula: $v_f^2 = v_0^2 + 2ad$ Answer: $26.72 \approx 27 m/s$	17. What is the acceleration of a car if it goes from rest to 43 m/s over a distance of 95 m? What we have: $v_0 = 0$ $v_f = 43 m/s$ $d = 95m$ What we want: a Formula: $v_f^2 = v_0^2 + 2ad$ Answer: $9.732 \approx 9.7 m/s$
18. What is the final velocity of a rocket which starts at 23 m/s and accelerates at 5.1 m/s² for 5.9 seconds? What we have: $v_0 = 23 m/s$ $a = 5.1 m/s^2$ $t = 5.9 sec$ What we want: v_f Formula: $v_f = v_0 + at$ Answer: $53.69 \approx 53 m/s$	19. What average velocity must a runner maintain if they want to run 10.0 **kilometers** in 45 **minutes?** What we have: $d = 10.0 km = 10\,000 m$ ← 3 sig figs $t = 45 min = 2700 sec$ What we want: $\bar{v}$ Formula: $d = \bar{v} t$ Answer: $0.22 \frac{km}{min}$ or $3.7 m/s$

20. Determine the two possible values for t by using the quadratic formula if:
$v_0 = -41$ m/s $d = -10.0$ m $a = 3.9$ m/s^2

$d = v_0 t + \frac{1}{2}at^2$
$-d \qquad -d$

$0 = v_0 t + \frac{1}{2}at^2 - d$

$0 = \frac{1}{2}at^2 + v_0 t - d$ (a, b, c)

$= \frac{1}{2}(3.9)t^2 + (-41)t + 10$

$= 1.95t^2 - 41t + 10$ (a, b, c)

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\frac{41 \pm \sqrt{(-41)^2 - 4(1.95)(10)}}{2(1.95)}$

$= 21$ sec or 0.25 sec

21. Determine the two possible values for t by using the quadratic formula if:
$v_0 = 23$ m/s $d = 6.3$ m $a = -6.8$ m/s^2

$0 = \frac{1}{2}at^2 + v_0 t - d$

$= \frac{1}{2}(-6.8)t^2 + 23t - 6.3$

$= -3.4t^2 + 23t - 6.3$ (a, b, c)

$\frac{-23 \pm \sqrt{23^2 - 4(-3.4)(-6.3)}}{2(-3.4)}$

$= 0.29$ sec or 6.5 sec

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22. You want to find displacement of an object, list three different formulas you could use and the other pieces of information you would need to find displacement using that formula.

Formula	$d = \bar{v}\,t$	$d = v_0 t + \frac{1}{2} a t^2$	$v_f^2 = v_0^2 + 2ad$
Extra info needed	$\bar{v}$ t	v_0 t a	v_0 v_f a

23. You want to find initial velocity of an object, list four different formulas you could use and the other pieces of information you would need to find initial velocity using that formula.

Formula	$v_f = v_0 + at$	$d = v_0 t + \frac{1}{2} a t^2$	$\bar{v} = \frac{v_0 + v_f}{2}$	$v_f^2 = v_0^2 + 2ad$
Extra info needed	v_f a t	d t a	$\bar{v}$ v_f	v_f a d

24. You want to find acceleration of an object, list three different formulas you could use and the other pieces of information you would need to find acceleration using that formula.

Formula	$V_f = V_0 + at$	$d = v_0 t + \frac{1}{2}at^2$	$V_f^2 = V_0^2 + 2ad$
Extra info needed	V_f V_0 t	d V_0 t	V_f V_0 d

$a = \frac{v}{t}$

v

t

25. You want to find time in a problem, list three different formulas you could use and the other pieces of information you would need to find time using that formula.

Formula	$d = \bar{v}t$	$V_f = V_0 + at$	$d = v_0 t + \frac{1}{2}at^2$
Extra info needed	d $\bar{V}$	V_f V_0 a	d V_0 a

26. A car is driving at 35 m/s when the driver sees an object 86.0 m ahead of the car. The driver breaks immediately with acceleration of -4.6 m/s².

   a. The driver will NOT be able to stop in time. How fast will the car be moving when it hits the object. Note what formula you used.

$V_0 = 35\,m/s$

$d = 86.0\,m$

$a = -4.6\,m/s^2$

$V_f = ?$

Use $V_f^2 = V_0^2 + 2ad$

$V_f = 20.828 \approx 21\,m/s$

   b. All else remaining the same, what is the maximum initial velocity the car could be travelling at and stop in time. Note what formula you used.

$d = 86.0\,m$

$a = -4.6\,m/s^2$

$V_f = 0\,m/s$

$V_0 = ?$

Use $V_f^2 = V_0^2 + 2ad$

$V_0 = 28.13 \approx 28\,m/s$

   c. All else remaining as it was in the original problem, what is the minimum acceleration that would be required to stop the car in time? Note what formula you used.

$d = 86.0\,m$

$V_f = 0\,m/s$

$V_0 = 35\,m/s$

$a = ?$

Use $V_f^2 = V_0^2 + 2ad$

$a = -7.122 \approx -7.1\,m/s^2$

27. A car is driving at 125 km/hr when the driver sees an object 65 metres ahead of the car. It takes the driver 0.35 seconds to react and then the car slows at 4.5 m/s^2. How fast will the car be moving when it hits the object?

Convert 125 km/hr into m/s

$$\frac{125\ km}{hr} \times \frac{1\ hr}{3600\ s} \times \frac{1000\ m}{1\ km} = 34.7222\ m/s$$

↑ Do not round as we will use it again

Break the problem into two parts

First part: Car moves with constant velocity until driver reacts	Second part: Car slows
What we have:	What we have:
$\bar{v} = 34.7222\ m/s$ $t = 0.35\ sec$	*Displacement* = **65m – displacement from first part =** 52.84722 m *Acceleration* = $-4.5\ m/s^2$ ← negative because it is slowing *Initial Velocity* = 34.7222 m/s
What we want: **Displacement**	What we want: v_f
Formula: $d = \bar{v}t$	Formula: $v_f^2 = v_o^2 + 2ad$
Answer: 12.15278 m ↑ Do not round yet	Answer: 27 m/s

28. A car accelerates to 56 km/hr from rest in 8.5 seconds, then drives at that speed for 19 seconds. What is the total distance they travel?

Convert 56 km/hr into m/s

$$\frac{56\,km}{hr} \times \frac{1\,hr}{3600\,sec} \times \frac{1000\,m}{1\,km} = 15.555556\,m/s$$

Break the problem into two parts

First part: Car accelerates.

We will need the acceleration of the car:

$$a = \frac{\Delta v}{\Delta t} = \frac{15.555556\,m/s}{8.5\,sec} = 1.8301\,m/s^2$$

What we have:

$t = 8.5\,sec$

$v_0 = 0\,m/s$

$a = 1.8301\,m/s^2$

$v_f = 15.55556\,m/s$

What we want: d

Formula: $d = v_0 t + \frac{1}{2} a t^2$

Answer: $66.11\,m$

Second part: Car drives with constant velocity

What we have:

$\bar{v} = 15.555556\,m/s$

$t = 19\,sec$

What we want: d

Formula: $d = \bar{v}\,t$

Answer: $295.56\,m$

Final answer:

$$66.11\,m + 295.56\,m = 361.66\,m \approx 360\,m$$

29. Two trains are driving towards each other on the same track! They are both travelling at 65 m/s and break at -1.4 m/s². What is the minimum distance the trains could be apart when they start breaking so that they do not crash?

Whatever distance one travels we double to get the total distance

$V_0 = 65\,m/s$

$a = -1.4\,m/s^2$

$V_f = 0$

$d = ?$

Use $V_f^2 = V_0^2 + 2ad$

$d = 1508.93\,m$

$\times 2$

$3017\,m \approx 3.0 \times 10^3\,m$

30. What is the average velocity of a car which starts at 56 km/hr and accelerates at a constant rate to 106 km/hr?

$V_0 = 56\,\frac{km}{hr}$

$V_f = 106\,\frac{km}{hr}$

$\bar{V} = \frac{V_f + V_0}{2}$

$= \frac{106\,\frac{km}{hr} + 56\,\frac{km}{hr}}{2}$

$= 81\,\frac{km}{hr}$

or $\approx 23\,\frac{m}{s}$

31. A car drives with an average velocity of 26 m/s for 250 m. How long did it take?

$\bar{v} = 26 \, m/s$

$d = 250 \, m$

$t = ?$

Use $d = \bar{v} t$

$t = 9.6$ ~~m/s~~ sec

32. A car, initially driving at 5.0 m/s, accelerates at a constant rate of 2.5 m/s^2 for 6.0 seconds. How far do they travel in those 6.0 seconds?

$v_0 = 5.0 \, m/s$

$a = 2.5 \, m/s^2$

$t = 6.0 \, sec$

$d = ?$

Use $d = v_0 t + \frac{1}{2} a t^2$

$d =$ ~~[illegible]~~

75 m

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33. A car, initially driving at 15 m/s accelerates at a constant rate of $0.56\ m/s^2$ over a distance of 450m. What is the final velocity of the car?

$V_0 = 15 m/s$

$a = 0.56 m/s^2$

$d = 450 m$

$V_f = ?$

$V_f^2 = V_i^2 + 2ad$

$V_f = 27 m/s$

34. A car is driving at a velocity of 20.0 m/s. If they slow at a rate of $4.00\ m/s^2$, how far will they travel before they stop?

$V_0 = 20.0 m/s$

$a = -4.00 m/s^2$

↑ negative since it is slowing at that rate

$V_f = 0$ ← Velocity is zero when they stop

$d = ?$

Use $V_f^2 = V_0^2 + 2ad$

$d = 50.0 m$

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Questions 35-39 are based on questions from Mr. Trask's Physics

35. A car is traveling at 108 km/h, stuck behind a slower car. Finally, the road is clear, and the car pulls over to make a pass. The driver stomps on the gas pedal and accelerates up to a speed of 135 km/h. If it took 3.50 s to reach this speed, what is the average acceleration of the car in m/s^2?

$$108 \frac{km}{hr} \times \frac{1\ hr}{3600 sec} \times \frac{1000 m}{1 Km} = 30 m/s$$

$$135 \frac{Km}{hr} \times \frac{1\ hr}{3600 sec} \times \frac{1000 m}{1 Km} = 37.5 m/s$$

$$a = \frac{\Delta v}{\Delta t} = \frac{37.5 - 30}{3.5} = 2.14 m/s^2$$

36. A driver has a reaction time of 0.50 s, and the maximum deceleration of her car is 6.0 m/s². She is driving at 100.0 km/hr when suddenly she sees an obstacle in the road 70.0 m in front of her. Can she stop the car to avoid the collision?

$$100.0 \frac{Km}{hr} \times \frac{1 hr}{3600 sec} \times \frac{1000 m}{1 Km} = 27.7778 m/s$$

Part one - not reacting yet - constant velocity

$$d = \bar{v} t = 13.89 m$$

Part two - slowing to a stop

$$d = v_0 t + \tfrac{1}{2} a t^2 \quad = \quad V_f^2 = V_0^2 + 2ad$$

$$d = 64.30 m$$

Total distance = 13.89 m + 64.30 m = 78.19 m

No, car travells 8.19 m past obstacle before stopping

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37. When a jet lands on an aircraft carrier, a hook on the tail of the plane grabs a wire that quickly brings the plane to a halt before it overshoots the deck. In a typical landing, a jet touching down at 240 km/h is stopped in a distance of 95 m. What is the jet's acceleration as it is brought to rest in m/s^2?

$$V_0 = \frac{240\,km}{hr} \times \frac{1\,hr}{3600\,sec} \times \frac{1000\,m}{1\,km} = 66.6667\,m/s$$

$V_f = 0$

Use $V_f^2 = V_0^2 + 2ad$

$d = 95\,m$

$a = -23.39\,m/s^2$

$\approx -23\,m/s^2$

38. A simple model for a person running the 100.0 m dash is to assume the sprinter runs with constant acceleration until reaching top speed, then maintains that speed through the finish line. If the sprinter reaches her top speed of 11.2 m/s in 2.14 s, what will be her total time?

(1) How far does she travel getting up to top speed

$V_0 = 0$

$V_f = 11.2\,m/s$

$t = 2.14\,sec$

Use $d = V_0 t + \frac{1}{2}at^2$

$d = 11.98\,m$

$$a = \frac{11.2\,m/s}{2.14\,sec} = 5.2336\,m/s^2$$

(2) How long does it take her to run rest of race

$\bar{v} = 11.2\,m/s$ $d = 100 - 11.98 = 88.02\,m$

$d = \bar{v}t$

$t = 7.86\,sec$

Total time $= 2.14\,s + 7.86\,s$

$= 10.0\,sec$

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39. An airplane travelling at an initial velocity of 120.0 m/s accelerates at 6.24 m/s^2 for 1000.0 m. How long does it take for them to travel the distance?

$v_0 = 120.0\,m/s$

$a = 6.24\,m/s^2$

$d = 1000.0\,m$

$t = ?$

(1) Use $v_f^2 = v_0^2 + 2ad$ to find v_f

$v_f = 163.9512\,m/s$

(2) Use $v_f = v_0 + at$ to find t

$t = 7.04$ sec

40. Two friends see each other across an airport. They were both at rest, 75 m apart and immediately start running towards each other. One of the friends accelerates at 1.3 m/s^2 while the other accelerates at 2.1 m/s^2. How long will it take until they meet?

Total distance covered by each pe

Displacement of person 1 + displacement of person 2 = 75m

Displacement of person 1 $= v_0 t + \frac{1}{2}at^2$
$= \frac{1}{2}(1.3)t^2 = 0.65t^2$

Displacement of person 2 $= v_0 t + \frac{1}{2}at^2$
$= \frac{1}{2}(2.1)t^2 = 1.05t^2$

$0.65t^2 + 1.05t^2 = 75$

$1.7t^2 = 75m \rightarrow t^2 = \frac{75m}{1.7\frac{m}{s^2}} \rightarrow t = 6.6$ seconds