Kinematics Review

MC

1. Which of the following situations involves the use of kinematics?

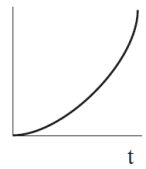
   A. Solving a back emf problem
   B. Solving a projectile motion problem
   C. Determining the internal resistance of a cell
   D. Determining the sum of two momentum vectors

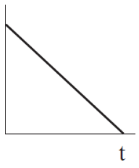
2. A projectile is launched at $35.0°$ above the horizontal with an initial velocity of 120 m/s. What is the projectile's speed 3.00 s later?

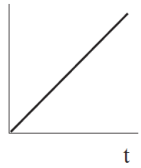
   A. 68.8 m/s
   B. 98.3 m/s
   C. 106 m/s
   D. 120 m/s

3. Which of the following graphs best illustrates the horizontal displacement of a projectile as a function of time? Ignore friction.

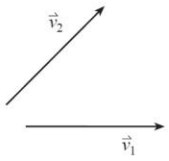
   A. 

   B. 

   C. 

   D. 

4. Two velocity vectors, v_1 and v_2 are shown.



Which of the following best represents the resultant of the addition of the two velocity vectors?

A. 

B. 

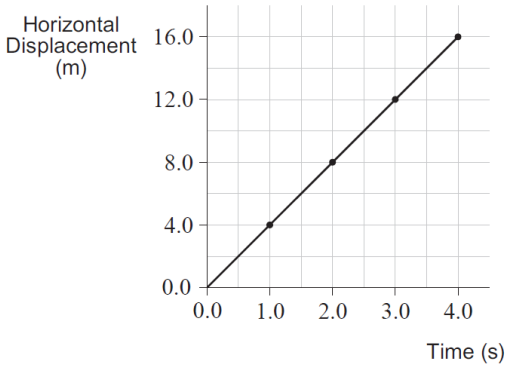
C. 

D. 

5. In landing, a jet plane decelerates uniformly and comes to a stop in 38 s, covering a distance of 1 500 m along the runway. What was the jet's landing speed when it first touched the runway?

   A. 2.1 m/s
   B. 39 m/s
   C. 79 m/s
   D. 170 m/s

6. A projectile is fired into the air at some angle above the horizontal. The horizontal displacement of the projectile is measured against time in flight and the collected data is shown as a horizontal displacement versus time graph.



Based on this graph, the horizontal velocity of the projectile during this time interval is

A. constant.
B. increasing.
C. decreasing.
D. equal to zero.

7. Which one of the following contains only vector quantities?

A. mass, time
B. force, velocity
C. time, momentum
D. acceleration, speed

8. A 35 kg object released from rest near the surface of a planet falls 7.3 m in 1.5 s. What is the acceleration due to gravity on this planet?

A. 4.9 m/s^2
B. 6.5 m/s^2
C. 9.7 m/s^2
D. 170 m/s^2

9. A projectile is fired with an initial velocity of 65 m/s at an angle of 23° above the horizontal. If air resistance is negligible, how much time elapses before the projectile reaches its maximum height?

A. 2.6 s
B. 2.8 s
C. 6.1 s
D. 6.6 s

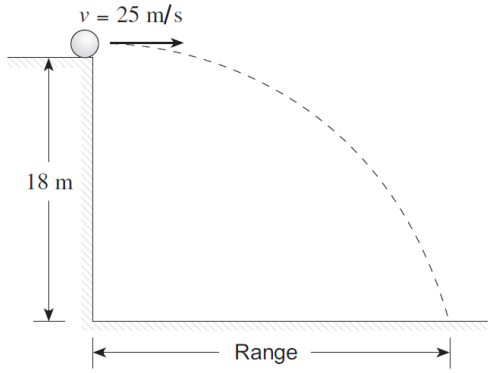
10. Which of the following contains only scalar quantities?

A. mass, speed
B. mass, velocity
C. displacement, speed
D. displacement, velocity

11. An airplane heads due north with an airspeed of 75 m/s. The wind is blowing due west at 18 m/s. What is the airplane's speed relative to the ground?

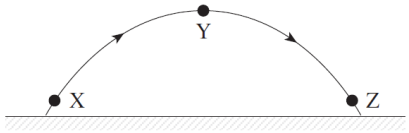
A. 57 m/s
B. 73 m/s
C. 77 m/s
D. 93 m/s

12. What is the range of the projectile launched horizontally at 25 m/s from the 18 m-high cliff edge as shown in the diagram below?



A. 18 m
B. 30 m
C. 46 m
D. 48 m

13. Consider three points in the path of a certain projectile as shown in the diagram below.



What is the acceleration of the projectile at each of these points?

	ACCELERATION (m/s^2)		
	At X	At Y	At Z
A.	+9.8	0	−9.8
B.	+9.8	0	+9.8
C.	−9.8	0	−9.8
D.	−9.8	−9.8	−9.8

14. A projectile is launched over level ground with an initial velocity of 65 m/s at 30° above the horizontal. What is the projectile's time of flight?

A. 3.6 s
B. 6.6 s
C. 11 s
D. 13 s

15. Which of the following is constant for all projectiles?

A. vertical velocity
B. horizontal velocity
C. vertical displacement
D. horizontal displacement

16. A projectile is launched at 30 m/s over level ground at an angle of 37° to the horizontal. What maximum height does this projectile reach?

A. 3.1 m
B. 17 m
C. 29 m
D. 46 m

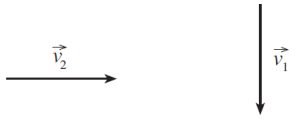
17. A few minutes after takeoff a jet is heading due east with an air speed of 300 km/h. If the wind is blowing at 60 km/h, towards 40° S of E, what is the jet's ground speed?

A. 260 km/h
B. 340 km/h
C. 350 km/h
D. 360 km/h

18. The velocity of a moving object as observed from another moving object is called its

A. relative velocity.
B. associated velocity.
C. differential velocity.
D. comparative velocity.

19. Consider the two vectors shown below.



Which of the choices given best represents $\vec{v}_2 - \vec{v}_1$?

A. 
B. 
C. 
D. 

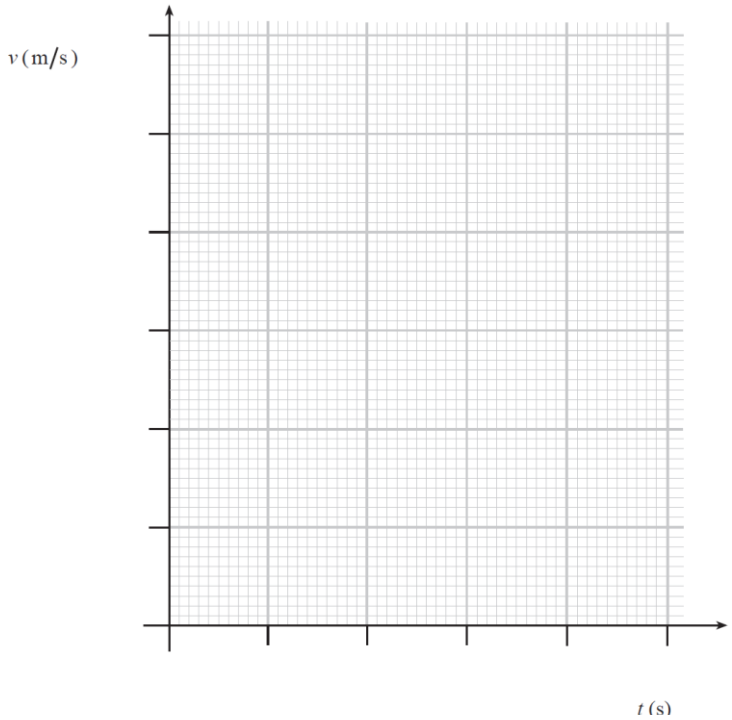
20. A green ball rolls off of the end of a table at 2.5 m/s. The table top is 1.5 m above the floor. How much time passes before the ball hits the floor?

A. 0.35 s
B. 0.55 s
C. 0.60 s
D. 1.2 s

WR 1. The data table shows the velocity of a car during a 5.0 s interval.

t (s)	0.0	1.0	2.0	3.0	4.0	5.0
v (m/s)	12	15	15	18	20	21

a) Plot the data and draw a best-fit straight line. **(2 marks**



b) Calculate the area bounded by the graph and the time axis between $t = 0.0$ s and $t = 5.0$ s. **(2 marks)**

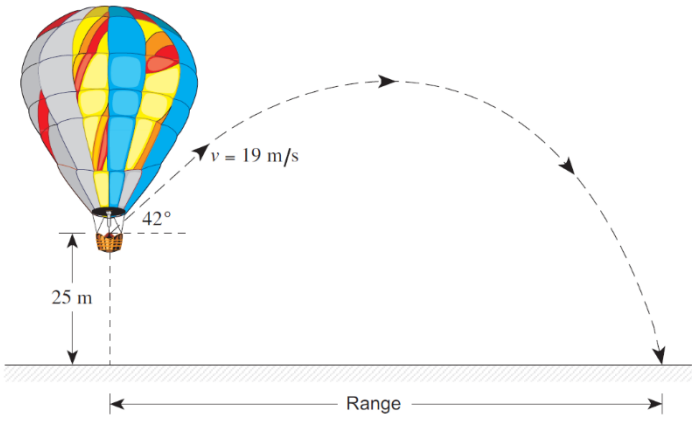
c) What does this area represent?

2. An aircraft heads due south with a speed relative to the air of 44 m/s. Its resultant speed over the ground is 47 m/s. The wind blows from the west.

a) What is the speed of the wind? **(4 marks)**

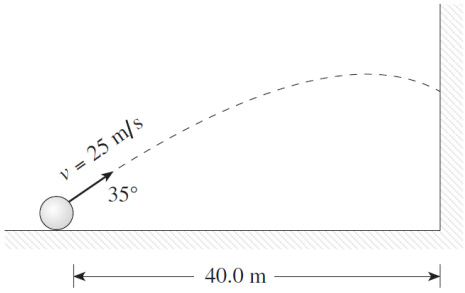
b) What is the direction of the aircraft's path over the ground? **(3 marks)**

3. A 0.50 kg ball is thrown at 42° above the horizontal at 19 m/s from a stationary hot air balloon 25 m above the ground.



What is the range?

4. A projectile is launched towards a wall as shown in the diagram below.

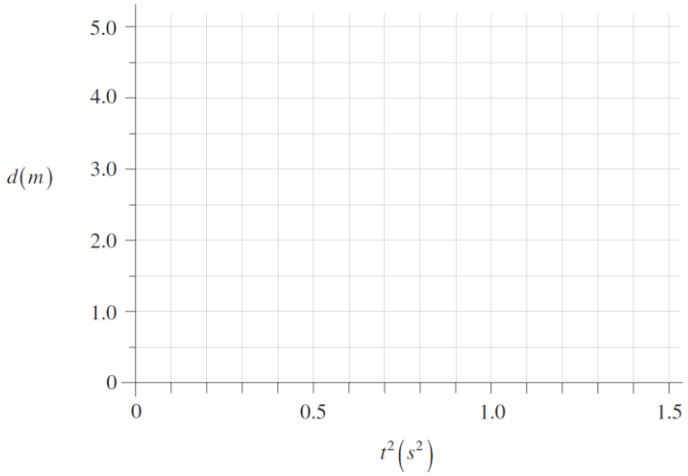


With what velocity (magnitude and direction) does the projectile hit the wall? **(7 marks)**

5. The first colonists on Mars conduct a physics experiment by dropping a small mass (from rest) and recording its displacement at regular time intervals. This data is shown below.

$d\ (m)$	$t\ (s)$	
0.30	0.40	
0.60	0.60	
1.20	0.80	
1.80	1.00	
2.70	1.20	

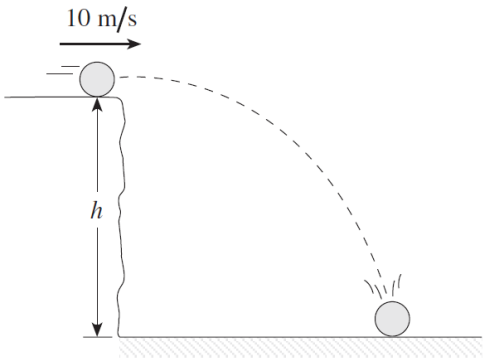
a) Plot a graph of displacement versus time squared and draw the best fit straight line.
(2 marks)



b) Determine the slope of the line.

c) Based on this experiment, what is the acceleration due to gravity on Mars? **(1**

6. A blue ball rolls off the cliff shown below at 10 m/s and hits the ground with a speed of 30 m/s.



a) What is the vertical component of the ball's impact velocity? **(4 marks)**

b) How high (h) is the cliff? **(3 marks)**

Answers

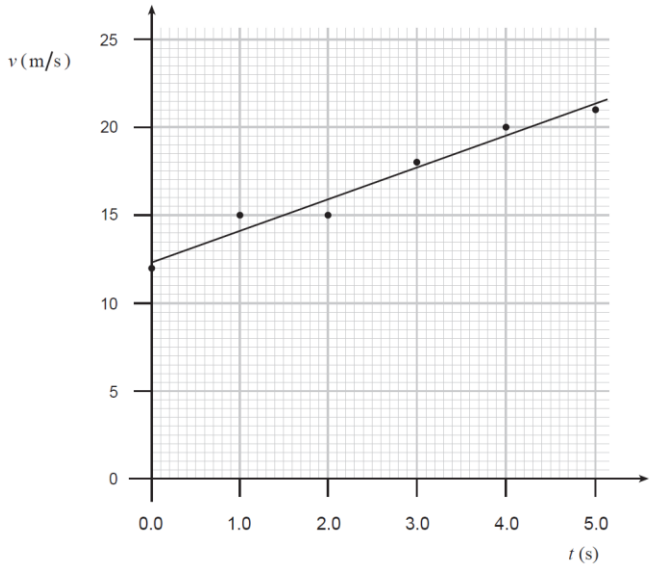
MC

1. b
2. c
3. d
4. c
5. c
6. a
7. b
8. b
9. a
10. a
11. c
12. d
13. d
14. b
15. b
16. b
17. c
18. a
19. a
20. b

WR

1.

a) Plot the data and draw a best-fit straight line. **(2 marks)**



b) Calculate the area bounded by the graph and the time axis between $t = 0.0$ s and $t = 5.0$ s. **(2 marks)**

$Area = \frac{1}{2}(a+b)c$

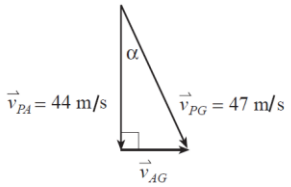
$\equiv 85$ m ← **2 marks**

c) What does this area represent? **(1 mark)**

The area represents the distance (displacement) travelled by the car in the time $t = 0$ to $t = 5$ s.

"Metres" only ← $\frac{1}{2}$ mark

2. a) What is the speed of the wind? **(4 marks)**



← **2 marks for diagram**

$v_{PA}^2 + v_{AG}^2 = v_{PG}^2$

$44^2 + v_{AG}^2 = 47^2$ } ← **1 mark**

$v_{AG} = 16.5$ m/s

$v_{AG} = 17$ m/s ← **1 mark**

b) What is the direction of the aircraft's path over the ground? **(3 marks)**

$\cos\alpha = \frac{44}{47}$ ← **1 $\frac{1}{2}$ marks**

$\alpha = 20.6°$

$= \underbrace{21°}_{\textbf{1 mark}}\ \underbrace{\text{east of south}}_{\frac{1}{2}\textbf{ mark}}$

or

69° south of east

3.

What is the range?

$v_x = 19 \times \cos 42° = 14.1$ m/s

$v_y = 19 \times \sin 42° = 12.7$ m/s } ← **1 mark**

$t_{up} = -\frac{v_y}{g} = -\frac{12.7}{-9.8} = 1.297$ s ← **1 mark**

$d_{up} = \frac{1}{2}at^2 = \frac{1}{2}9.8(1.297)^2$

$= 8.25$ m ← **1 mark**

$d_t = 25 + 8.25 = 33.25$ m ← **$\frac{1}{2}$ mark**

$t_d = \sqrt{\frac{2 \times d_t}{a}} = \sqrt{\frac{2 \times 33.25}{9.8}} = 2.60$ s ← **1 mark**

$t_t = t_{up} + t_d = 1.297 + 2.60 = 3.90$ s ← **$\frac{1}{2}$ mark**

$d_x = v_x \times t = 14.1 \times 3.90 = 55$ m (Range) ← **2 marks**

4. With what velocity (magnitude and direction) does the projectile hit the wall? **(7 marks)**

$d_x = v_x \cdot t$

$v_x = v \cdot \cos 35$

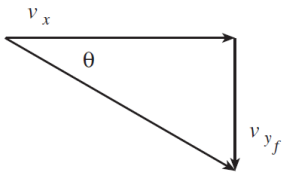
$= 25 \cdot \cos 35$ ← **1 mark**

$= 20.5$ m/s

$\therefore t = \dfrac{d_x}{v_x}$

$= \dfrac{40.0}{25 \cdot \cos 35}$

$= 1.95$ s ← **1 mark**



$\theta = \tan^{-1}\left(\dfrac{v_{y_f}}{v_x}\right)$

$= \tan^{-1}\left(\dfrac{4.77}{20.5}\right)$

$= 13°$ ← **2 marks**

$v_{y_f} = v_{y_i} + at$

$= 25 \cdot \sin 35 + (-9.8 \cdot 1.95)$ ← **1 mark**

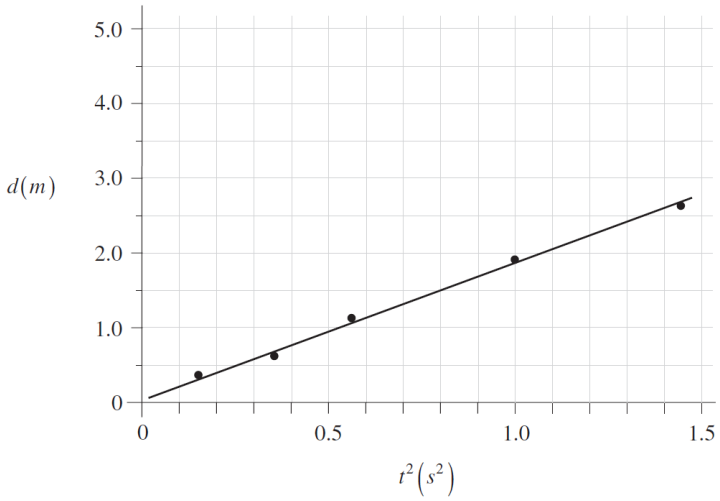
$= -4.77$ m/s ← **1 mark**

$\therefore v^2 = v_x^2 + v_{y_f}^2$

$= (20.5)^2 + (-4.77)^2$

$\therefore v = 21$ m/s ← **1 mark**

5. a) Plot a graph of displacement versus time squared and draw the best fit straight line. **(2 marks)**



b) Determine the slope of the line. **(2 marks)**

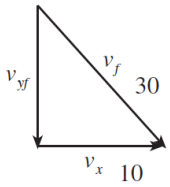
slope ≅ 1.9 m/s^2

c) Based on this experiment, what is the acceleration due to gravity on Mars? **(1 mark)**

≅ 3.8 m/s^2

6.

a) What is the vertical component of the ball's impact velocity? **(4 marks)**



← **1 mark**

$v_{yf}^2 = v_f^2 - v_x^2$ ← **2 marks**

$v_{yf}^2 = 30^2 - 10^2$

$v_{yf} = -28.3 \text{ m/s}$ ← **$\frac{1}{2}$ mark for magnitude, $\frac{1}{2}$ mark for direction**

b) How high (h) is the cliff? **(3 marks)**

$v_{yf}^2 = v_{yi}^2 + 2(a_g)d_y$ ← **2 marks**

$-28.3^2 = 0^2 + 2(-9.8)d_y$

$d_y = -40.9 \text{ m}$ ← **1 mark**

$\therefore h = 41 \text{ m}$