MURDOCH COLLEGE

YEAR 12
PHYSICS
2006

MOVEMENT
TEST 1

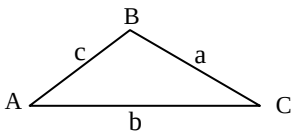
50 marks total = 3% of year mark

Formulas

$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$

Mathematical expressions

Given $ax^2 + bx + c = 0$, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$



$b = \sqrt{a^2 + c^2 - 2ac\cos B}$

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

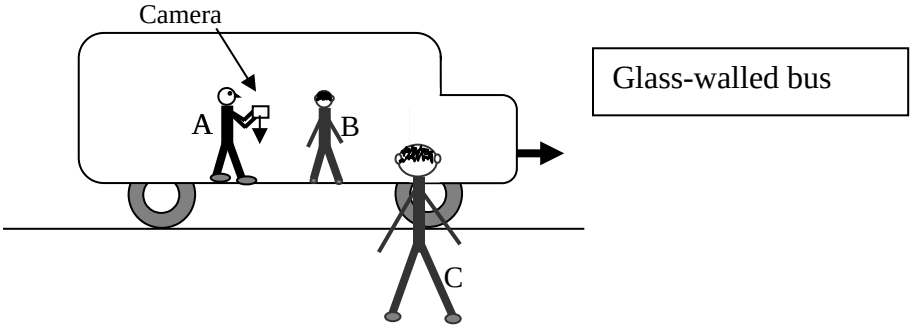
Remember: velocity, and change in velocity, has magnitude and direction

Legal name _____

Preferred name _____

Teacher _____

1. Man A is standing in a moving, glass-walled bus holding his camera when it falls from his hand. Another passenger in the bus (man B) sees the camera fall to the floor. Another person (woman C), standing on the pavement outside the bus, can also see the camera fall, looking through the walls of the bus.



Draw below the trajectory (path) of the camera as it falls, as seen by man B, and as seen by and woman C.

Man B's view

Woman C's view

[2 marks]

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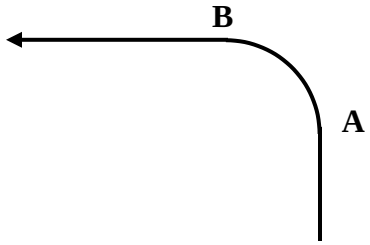
2. A car travelling north turns west maintaining a constant speed of at 10.0 ms^{-1} .



a) Draw three arrows that show the directions of the car's

(i) initial velocity (**U**)

(ii) final velocity (**V**), and

(iii) change in velocity (**ΔV**)

change in velocity as it travels from A to B.

[3 marks]

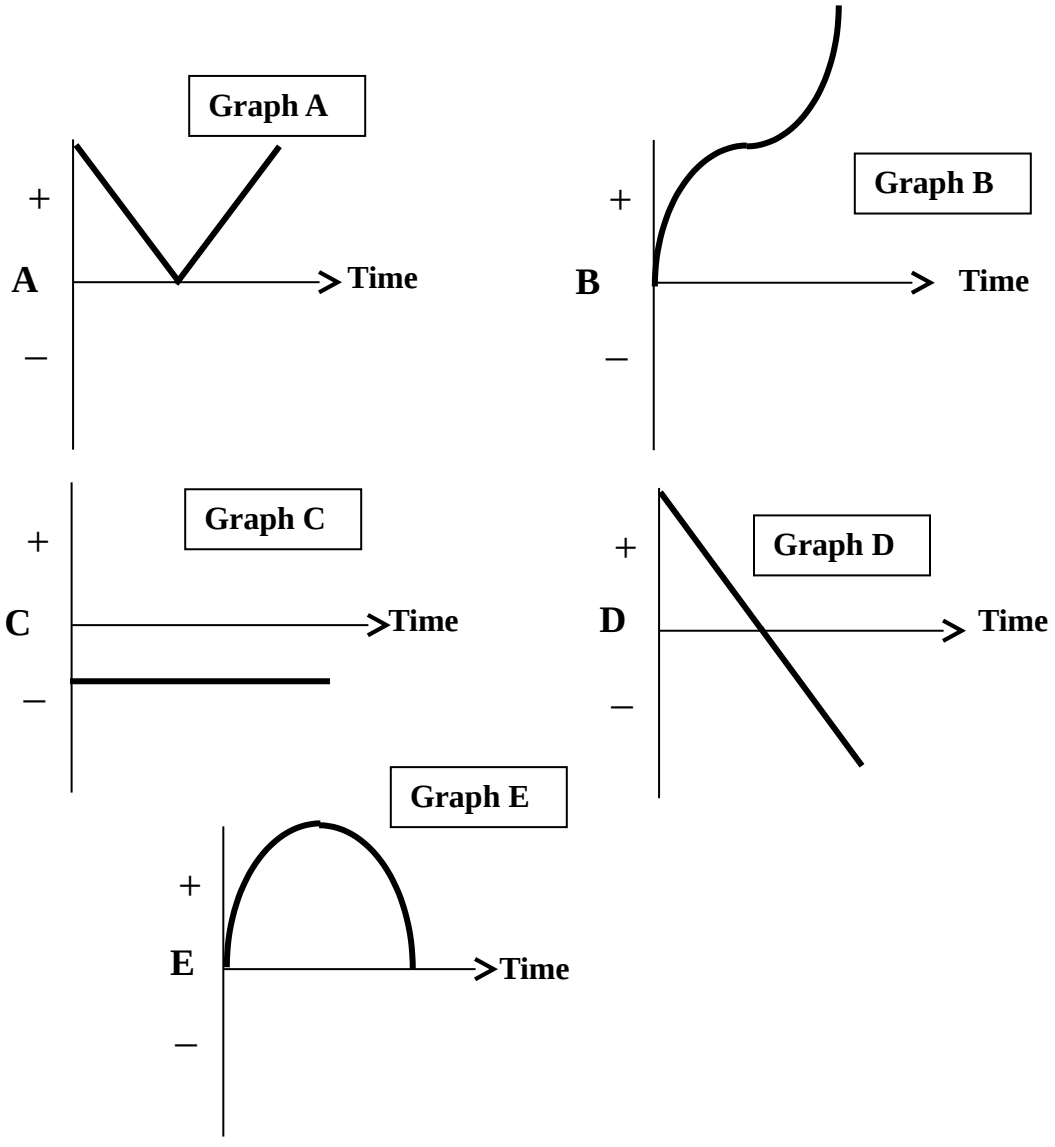
b) Calculate the magnitude of the car's change in velocity.

[2 marks]

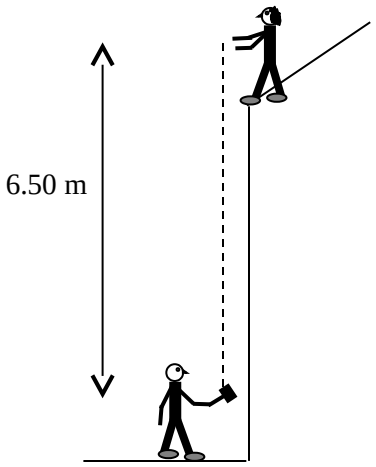
3. An arrow is shot vertically upwards.
The graphs below show how each of five variables changes with time.
For each variable choose one graph that correctly shows how that variable changes.

Variable	Graph representing how that variable changes with time (A, B, C, D or E)
Speed	
Velocity	
Distance travelled	
Displacement	
Acceleration	

[5 marks]



4. A woman roof-tiler, working 6.50 m up on a roof needs a hammer so she calls to her mate Jim to throw a hammer up to her.



a) With what velocity must Jim throw the hammer for it to just reach her hand 6.50 m above?

[3 marks]

b) Unfortunately, Jim throws the hammer too fast (at 13.0 ms^{-1}) so the hammer rises too high. The tiler misses it on the way up, but catches it while it is on its way down again.
How long after it is thrown will she catch the hammer?

[3 marks]

5. In the 2006 Winter Olympics a skier is moving due South at a velocity of 18.5 ms^{-1} on a snow track. A wind starts to blow from the East with a velocity of 10.2 ms^{-1}

a) What is the resultant velocity of the skier on the track?

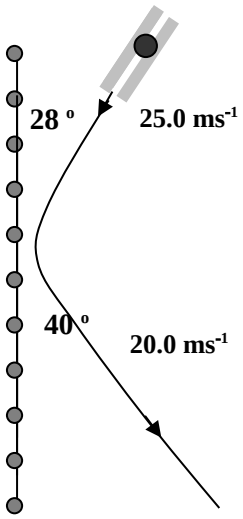
[4 marks]

b) If the skier wants to remain travelling due South at the same speed with this wind blowing, with what velocity does he need to move?

[4 marks]

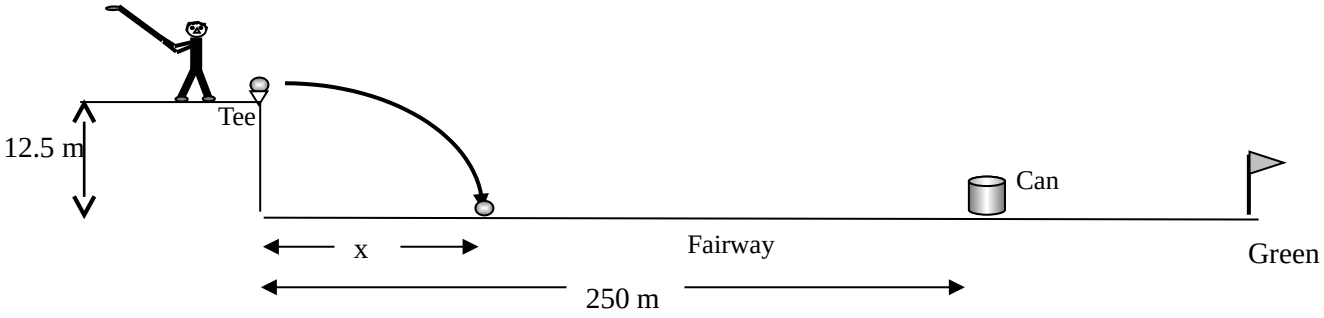
c) Another downhill skier is moving at 25.0 ms^{-1} at an angle of 28^0 to a fence which runs North-South. To avoid the fence the skier has to change direction, as shown, so that he is now moving away from the fence at an angle of 40^0 with a speed of 20.0 ms^{-1}.

Calculate the change in velocity of the skier at the fence.



[4 marks]

6. A driving range is a place where golfers practise their swing by hitting lots of balls, one after the other.
In one Japanese driving range the balls are hit from up on a tee 12.5 m above the fairway and onto the green. Esmeralda hits her golf ball at a velocity of 42.0 ms^{-1} horizontally off the tee.



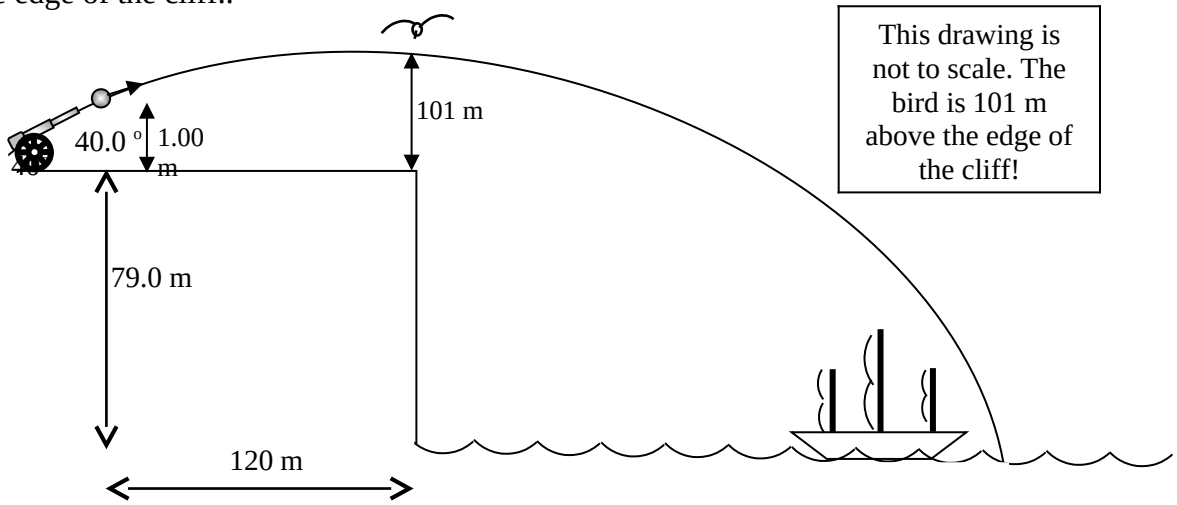
a) How far away does Esmeralda's ball land (distance x)?

[4 marks]

b) A tin can has been set up 250 m away from the tee with a prize for anyone who can get their ball into it.
How fast must Esmeralda hit her ball to get it into the can?

[3 marks]

7. Sir Francis Drake positioned his cannon 120 m from the edge of the Dover Cliffs, which were 79.0 m above sea level. He angled the cannon barrel at 40^0 to the ground to fire a cannonball at 150 ms^{-1} towards a Spanish Armada ship out at sea so the ball was projected from 1.00 m above the ground and 120 m from the edge of the cliff..



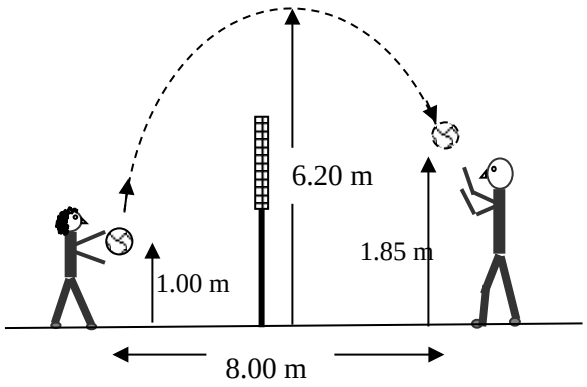
a) How far out to sea did the cannonball land?

[4 marks]

b) A seagull is flying directly over the edge of the cliffs at a height of 101 m above the ground. Does the cannonball hit the seagull?

[4 marks]

8. During a volleyball match Jenny serves the ball to Chris from a point 1.00 m above the ground.
The ball travels to a height of 6.20 m above the ground and then later is struck by Chris at a point 1.85 m above the ground. Jenny and Chris are separated by a distance of 8.00 m.

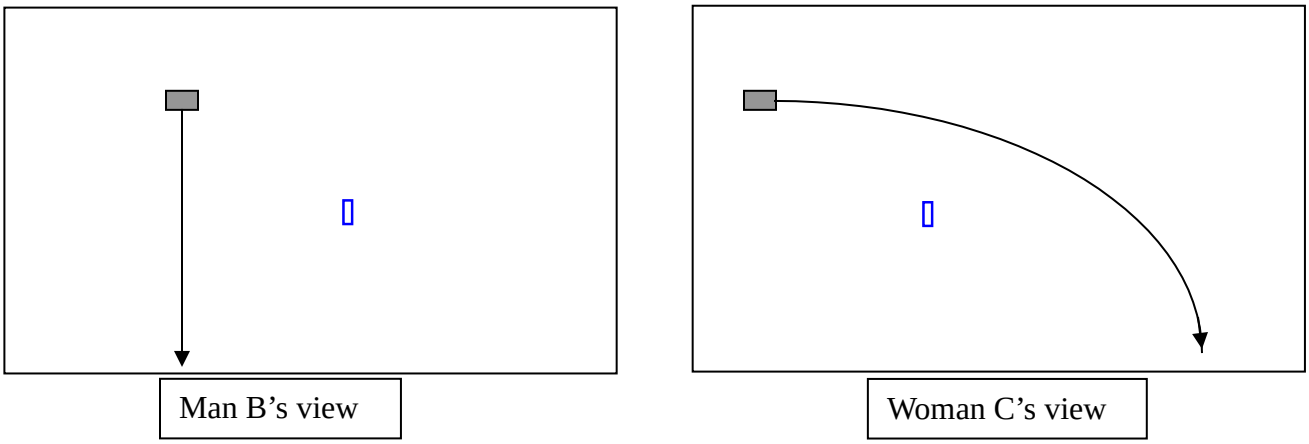


Calculate the velocity of the ball as it leaves Jenny's hand.

[5 marks]

Answers

1.



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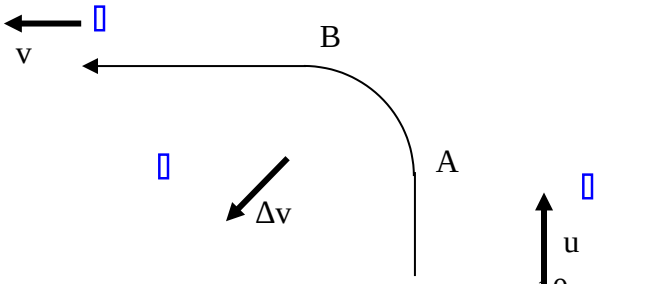
2. a)



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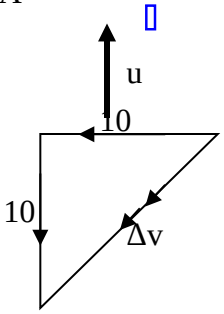
b) $\Delta v^2 = 10^2 + 10^2$

$\Delta v = 14.1$ ms^{-1}



2

3. Speed = A

Velocity = D

Distance travelled = B

Displacement = E

Acceleration = C

5

4. a) $v^2 = u^2 + 2as$ $0 = u^2 + 2 \times 9.8 \times 6.5$ = **11.3 ms^{-1}**

3

b) $s = ut + \frac{1}{2} at^2$ $6.5 = 13t - 4.9t^2$

Solver: t = 0.67 s or **1.99 s** (this is the time on the way down.

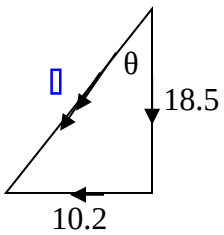
3

5. a) $R^2 = 18.5^2 + 10.2^2$

R = 21.1 ms^{-1}

4

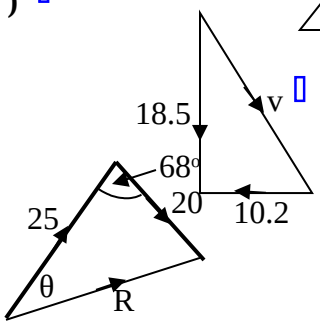
Tan θ = 10.2/18.5 θ = S28.9 W **(209º)**



b) $v^2 = 18.5^2 + 10.2^2$ **v = 21.1 ms^{-1}**

4

Tan θ = 10.2/18.5 θ = S28.9ºE **(151º)**



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c) Cos rule:

$R^2 = 25^2 + 20^2 - 2 \times 25 \times 20\cos 68$

R = 25.5 ms^{-1}

Sine rule:

$\frac{20}{\sin\theta} = \frac{25.5}{\sin 68}$ **θ = 46.6º** or 74.7 S of E

4

6. a) Vertically: $-12.5 = 0 - 4.9t^2$ t = 1.597 s

Horizontally: s = ut = 42 x 1.597 = **67.1 m**

4

b) At a higher horizontal speed the time to reach the ground will be the same (1.597 s)

So new velocity = s/t = 250/1.597s = **157 ms^{-1}**

3

7. a) $u_H = 150\cos 40 = 114.9$ ms^{-1} $u_v = 150\sin 40 = 96.4$ ms^{-1}

Vertically: $s = ut + \frac{1}{2}at^2$ $-80 = 96.4t - 4.9t^2$

Solver: t = 20.47 s

Horizontally: s = ut = 114.9 x 20.47 = 2352 m (subtract 120) S = **2232 m from cliff base**

4

b) Horizontally: Time to travel 120 m is $t = \frac{120}{150\cos 40} = 1.044$ s

Vertically: $s = ut + \frac{1}{2}at^2 = 96.4 \times 1.044 - 4.9 \times 1.044^2$

= 95.33 m **(97.33 m from ground)** Hence the ball misses the seagull.

4

8. Vertically

s = 5.20 $v^2 = u^2 + 2as$

a = -9.8 $0 = u^2 - 19.6 \times 5.2$

v = 0 $u_v = 10.1$ ms^{-1}

u_v = ?

Time of flight:

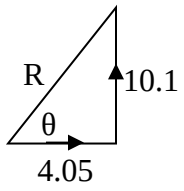
Vertically: $s = ut + \frac{1}{2}at^2$ $0.85 = 10.1t - 4.9t^2$

Solver: t = 1.97 s

Horizontally: v = s/t = 8/1.97 = 4.05 ms^{-1}

$V_T^2 = 4.05^2 + 10.1^2$ **V_T = 10.9 ms^{-1}**

Tanθ = 10.1/4.05 **θ = 68.1º**



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