**COMET BAY COLLEGE**

**Physics - Unit 2 - Task 3**

**Motion Test 1**

**Name: Total Marks /56**

Note: Show working for all mathematical answers.

**Question 1** :

At the 2011 Davis Cup, Ivo Karlovic broke the record for the fastest tennis serve. Over the length of the court (23.78 m) the ball took only 0.341 seconds to reach the opponent.

a) What is the speed in m s-1? (2 marks)

v = = (1 mark)

v = 69.74 m s-1  (1 mark)

b) What is the speed in km h-1? (2 marks)

v = 69.73 × (1 mark)

v = 251.05 km h-1  (1 mark)

**Question 2** **:**

Thomas the turtle at Perth zoo travels 0.3m in 10.8 seconds on average. What is the average speed of this reptile in ms-1? (2 marks)

v = = (1 mark)

v = 0.0278 ms-1 (1 mark)

**Question 3:**

A car is travelling Northwest at a speed of 35 ms-1 when a man throws a can out of the right window at a speed of 10 ms-1 at right angles to the car. What is the resultant of the can relative to the ground? (4 marks)

R2 = 352 + 102 (1 mark)

R = 36.4 ms-1 (1 mark)

Ø = tan-1 () = 16o (1 mark)

Angle is 16o + 45o = 61o

R = 36.4 ms-1 W61oN (1 mark)

10

Ø

35

R

45

**Question 4** **:**

Below is a graph showing the displacement over time of a moving car. NOTE: between t = 0 and t = 10 the displacement is parabolic.

Displacement (m)

Tangent of Line AB at Point B

**E**

**D**

**B**

**C**

**A**

Time (s)

Tangent of Line AB at Point B

2

1

0

-1

-2

S1: vi= 0 (1)

vf = = 2.5 (1)

S2: v = 0 (1)

S3: v = = -2(1)

S4: v = = 2 (1)

S1

S2

S3

S4

On the two blank graphs below, draw up the corresponding ;

a) velocity versus time graph (show working on side), and (5 marks)

b) acceleration versus time graph (show working on side). (4 marks)

0.2

0.1

0

-0.1

-0.2

S1: a = = 0.25 (1)

S2: a = 0 (1)

S3: a = 0 (1)

S4: a = 0 (1)

S1

S2

S3

S4

**Question 5:**

James was driving home at night when a kangaroo jumped out onto the road 48m in front of the car. Being dazzled by the car’s headlights, it stopped, staring at the oncoming vehicle. It took James 0.18 s before he applied the brakes that slowed his car from 18.2 ms-1 to zero with a deceleration of 3.75 ms-2. Did James miss the kangaroo? (6 marks)

Two displacements to consider

s1: u = 18.2 ms-1 and t = 0.18 s

v = , hence s1 = v × t = 18.2 × 0.18 = 3.276 m (1 marks)

s2: u = 18.2 ms-1, v = 0 (1 mark) and a = 3.75 ms-1

v2 = u2 + 2as

0 = 18.22 + 2 × -3.75 × s (1 mark)

s = 44.165 m (1 mark)

sT = s1 + s2

sT = 3.276 + 44.165 (1 mark)

sT = 47.44m (1 mark)

Yes he just misses the kangaroos by 0.56 m (1 mark)

**Question 6:**

Jenny is dropping her kids off to child care. She pulls out of her drive way with an acceleration of 0.3 m s-2, which she maintains for 1.5 minutes. She then remains at this constant speed for 8 minutes, before taking 20 seconds to slow to a stop in front of the child care. Calculate

a) Jenny’s maximum velocity. (3 marks)

Forward as positive

a = +0.3 ms-2 v = u + at

u = 0 (1 mark) v = 0 + 0.3 × 90 (1 mark)

t = 1.5 × 60 = 90 s v = 27 ms-1 (1 mark)

v = ?

(1 mark)

b) Her deceleration in the last 20 seconds. (4 marks)

Forward as positive

u = 27 ms-1 v = u + at

v = 0 ms-1 (1 mark) 0 = 27 + a × 20 (1 mark)

t = 20 s a = -1.35 ms-2 (1 mark)

a = ? decelerates at 1.35 ms-2 (1 mark)

(1 mark)

c) The distance to the child care centre. (8 marks)

**At time 0 to 90 sec**

a = 0.3 ms-2 s = ?

t = 90 s s = ut + ½at2 v2 = u2 +2as

u = 0 s = 0 + ½ × 0.3 × 902 (1 mark) 272 = 02 + 2 x 0.3 x 5

v = 27 ms-1 s = 1215 m(1 mark) s = 1215 m

**At time 90 to 570 sec**

v = 27 ms-1 s = vt

t = 8 × 60 = 480 s s = 27 × 480 (1 mark)

s = 12960 m(1 mark)

**At time 570 to 590 sec**

a = -1.35 ms-2 s = ?

t = 20 s s = ut + ½at2

u = 27 ms-1  (1 mark) s = 27 × 20 + ½ × -1.35 × 202 (1 mark)

v = 0 ms-1 s = 270 m(1 mark)

**Total distance =** 1215 + 12960 + 270 = 14445 m = 1.44 × 104 m (1 mark)

d) Her average speed over the entire journey. (2 marks)

s = 1.44 × 104 mv = =

t = 590 s (1 mark) v = 24.4 ms-1 (1 mark)

(1 mark)

**Question 7:**

A rocket moves straight upward, starting from rest with an acceleration of 24.9 ms-2. It runs out of fuel after 4.0 s and continues upward to a maximum height before falling back to Earth.

a) Find the rockets velocity at the point it runs out of fuel (t = 4s)? (3 marks)

Up as positive

a = +24.9 ms-2 v = u + at

t = 4 s v = 0 + 24.9 × 4 (1 mark)

u = 0 (1 mark) v = 99.6 ms-1 (1 mark)

v = ?

(1 mark)

b) Find the maximum height the rocket reaches. (7 marks)

Up as positive

**For s2:**

a = -9.8 ms-2 v2 = u2 + 2as or v = u + at and s = ut + ½ at2

s2 u = 99.6 ms-1 (1 mark) 0 = 99.62 + 2 × -9.8 × s2 (1 mark)

v = 0 s2 = 506.13 m (1 mark)

s2 = ?

s1 **For s1:**

a = +24.9 ms-2 s1 = ut + ½ at2

u = 0 (1 mark) s1 = 0 + ½ × 24.9 × 42 (1 mark)

t = 4 s s1 = 199.2 m (1 mark)

s1 = ?

Total height = s1 + s2 = 506.13 + 199.2 = 705.33 m (1 mark)

**Question 8 :**

A biker speeding along at 35 km h-1 slams on his brakes and decelerates to 8 km h-1 in 1.5 s. What was his average acceleration? (4 marks)

u = 35 km h-1 = 9.72 m s-1 (1 mark) v = u + at

v = 8 km h-1 = 2.22 m s-1 2.22 = 9.72 + a × 1.5 (1 mark)

t = 1.5 s a = - 5 m s-2 (1 mark)

a = ? decelerates at 5 m s-2 (1 mark)

**Question 9 :**

An archer shots an arrow from a height of 1.2 m above the ground, at a velocity of 12 m s-1 and an angle of 30o up from horizontal. It hits the target 28 metres away which is also at a height of 1.2 metres.

1. What is the time spent in flight for the arrow? (3 marks)

Horizontal

uH = 12 cos 30 t = sH .

uH = 10.4 m s-1 (1 mark) uH

a = 0 m s-2  = 28 . (1 mark)

sH = 28 m 10.4

= 2.69 s (1 mark)

1. What is the maximum height from the ground? (4 marks)

Vertical

Up is positive

uV = 12 sin 30

uV = 6 m s-1

a = -9.8 m s-2

vV = 0 m s-1 (1 mark)

v2 = u2 + 2as

s = v2 – u2

2 a

= 02 – 62 . (1 mark)

2 × -9.8

= 1.84 m up from the origin (1 mark)

3.04 m up from the ground (1 mark)

sH .

uH

= 28 .

10.4

= 2.69 s