P11½

BAULKHAM HILLS HIGH SCHOOL

HALF YEARLY EXAMINATION

2011

YEAR 11

PHYSICS

GENERAL INSTRUCTIONS

- Reading Time - 5 min
- Working Time – 1.5 hours
- Board approved calculators may be used
- Write, using black or blue pen only
- Draw diagrams in pencil
- A Data Sheet and Formulae Sheets are provided at the back of this paper
- Show all relevant working

TOTAL MARKS: 64

Part A – Multiple Choice
15 marks

Part B – Short and long Response
49 marks

Answer **ALL** questions in the spaces provided

Candidate Number : ………………………………………….……….. Teacher: ……………………….

YOU CAN TEAR THIS SHEET FROM THE PAPER

BAULKHAM HILLS HIGH SCHOOL

YEAR 12

HALF YEARLY EXAMINATION

2011

PHYSICS

MULTIPLE CHOICE ANSWER SHEET

(Cross (X) the most correct answer, A, B, D or C for each question)

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D

Candidate Name: ....

Part A – Multiple Choice
15 marks
Indicate the most correct answers with crosses (X) on the grid provided on the Answer Sheet. The Answer Sheet is on the back of the front cover and should be off for your use.

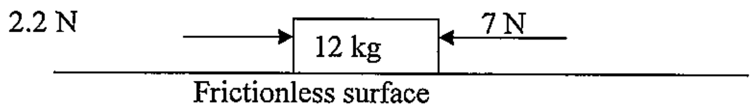
1. Average speed is:

   a) the total distance travelled divided by time taken.
   b) the average of the first and last instantaneous speeds.
   c) constant throughout a journey.
   d) a vector quantity.

2. A car has a mass of 1 450 kg on the Earth. The acceleration due to gravity on the Moon is 1.6ms^{-2}. The weight of the car on the Moon would be:

   a) 14 210 kg
   b) 2 320 kg
   c) 1 450 kg
   d) 242 kg

3.



   The net acceleration in this situation is

   a) 4.8 ms^{-2} left
   b) 4.8 N left
   c) 0.4 ms^{-2} left
   d) 57.6 ms^{-2} left

4. A car is moving along a flat road at 50 km/h and runs out of petrol. The driver takes it out of gear and lets it slowly coast to a stop. Besides the lack of petrol, the car slowly stopped because

   a) the total force on the car was zero
   b) the weight is equal to the reaction force of the road
   c) its mass was less without the petrol
   d) friction and air resistance were the only horizontal forces

5. A situation described below that best illustrates Newton's Second Law is:

   a) two cars colliding and coming to rest.
   b) passengers in a car continuing to move forward when the car stops suddenly.
   c) a large truck taking longer to stop than a small car travelling at the same speed.
   d) as a car accelerates on a gravel road, gravel is thrown backwards from the tyres.

6. Consider "two stationary ice skaters standing in the middle of an ice skating rink. When only one skater pushes the other, both move away from each other." This is an example of:

a) Newton's First Law of Motion
b) Newton's Second Law of Motion
c) Newton's Third Law of Motion
d) None of the above.

7. Two objects of different masses, traveling in opposite directions, collide, coalesce and move off with a common speed. Which statement is true?

a) Momentum has not been conserved.
b) Neither momentum nor kinetic energy has been conserved.
c) Momentum is conserved but kinetic energy has not.
d) This is an example of an elastic collision.

8. A car pulls a caravan of mass 1200 kg on a straight horizontal road. The tension in the coupling between the car and the caravan is 100N. Calculate the work done after 30 minutes if the average speed of the car is 15 ms^{-1}.

a) 27 kJ
b) 270 kJ
c) 2700 kJ
d) 27 000 kJ

9. Two forces, 7N and 9N are acting on a 500g mass on a frictionless surface in opposite directions. As a result of these forces, what would the momentum of this mass be after 0.5 second:

a) 1 kg ms^{-1}
b) 10 kg ms^{-1}
c) 100 kg ms^{-1}
d) 1000 kg ms^{-1}

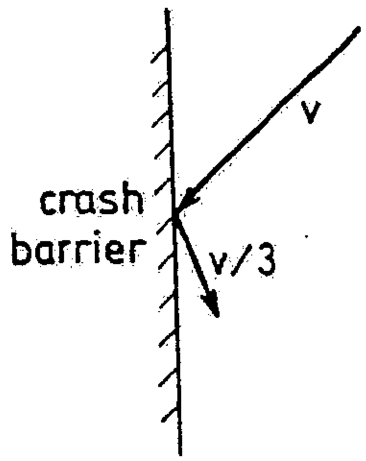
10. Consider a snowboarder going down a slope. The weight component 'pushing' him down the slope is 300.0 N, friction between the board and the snow is 80.0 N and the air resistance is 60.0 N. Calculate the net force on the boarder.

a) 160.0 N
b) 220.0 N
c) 240.0 N
d) 300.0 N

11. An astronaut has a mass of 80 kg on the moon. The acceleration due to gravity on the moon is 1.6 m s^{-2}. The mass of the person on the Earth is closet to:

a) 784 kg
b) 128 kg
c) 12.8 kg
d) 80 kg

12. A car travelling on a horizontal road surface at velocity v collides with a crash barrier and comes off intact with a velocity $v/3$ as shown in the diagram below.

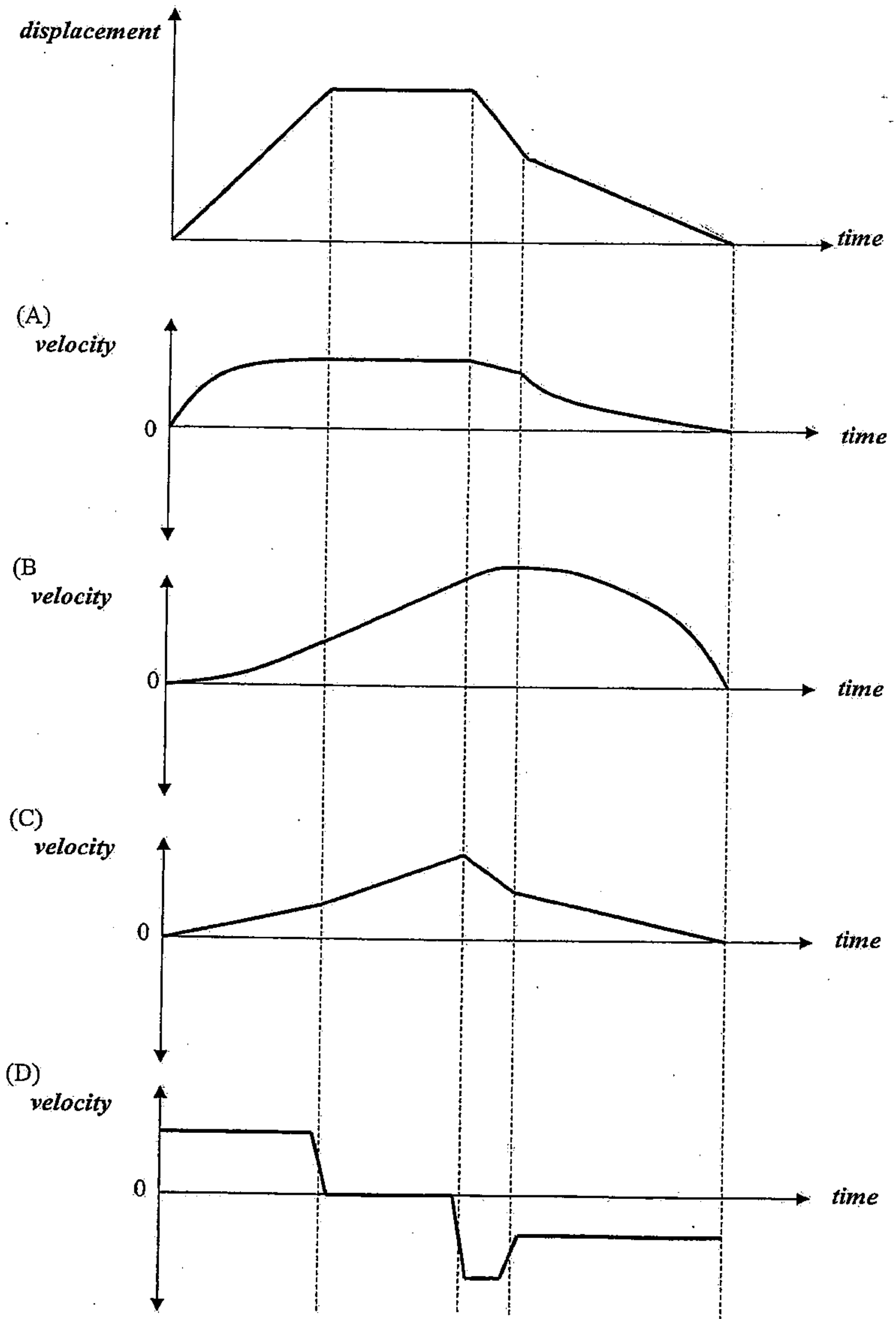


The kinetic energy of the car before the collision is E. The kinetic energy lost by the car in the collision is

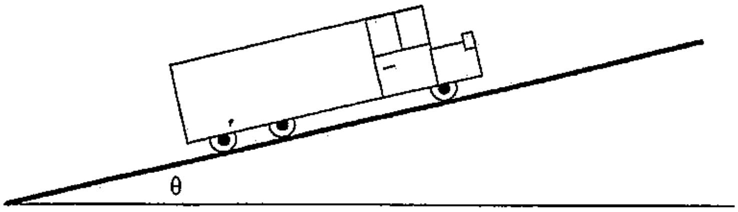
a) $E/3$
b) $8E/9$
c) $2E/3$
d) $E/9$

Q13 is on the next page

13. Which velocity versus time graph best corresponds with the displacement versus time graph?

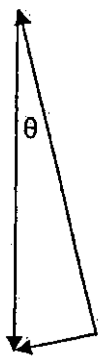


14. A truck is travelling with constant speed up an incline as shown. The angle of the incline is shown



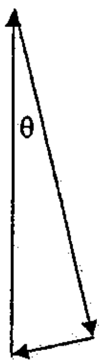
Ignoring friction, which diagram below best represents the forces (not shown on the diagram) acting on the truck?

(A)

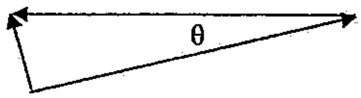


(B)

(C)



(D)



15. What is the main reason for introducing devices such as air bags and crumple zones in cars?

a) The momentum of the cars will be reduced when they have a collision.
b) The impulse on the cars during collisions will be reduced.
c) The forces on the cars during collisions will be reduced.
d) The time of contact between colliding cars will be reduced

End of Part A

Candidate Name: ....

Part B – Extended Response
49 marks
Answer all questions in the spaces provided

Marks

Question 16 (2 marks)

Describe the difference between average speed and instantaneous speed? **2**

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....

....

Question 17 (3 marks)

A man is walking east at 1.5 m/s, while a skateboard rider overtakes him travelling (in the same direction) at 7.5 m/s.

a) What is the relative velocity of the skateboarder with reference to the walker? **1**

....

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....

b) If a skateboard rider is travelling at 3 ms^{-1} North and the relative velocity of him to a walker is 4.24 ms^{-1} North West, find the velocity of the walker. **2**

....

....

....

Question 18 (4 marks)

A roofing tradie broke his ankle falling off a ladder from a height of 2.5m.

a) Calculate his final velocity before the ground stopped him from moving. **2**

....

....

b) Assume the tradie has a mass of 90 kg. Determine the kinetic energy (E_k) he gained in the fall. **1**

....

....

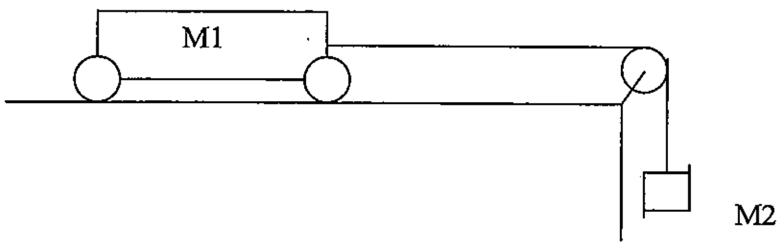
c) When he hit the ground, what has happened to the kinetic energy? **1**

....

....

Question 19 (4 marks)

Consider the following experiment:



a) How would you change M1 to increase the acceleration of the trolley? **1**

....

b) Assume M1 is 1.6 kg, and M2 is 0.2 kg. What is the total mass of the moving system? **1**

....

c) Find the force of gravity acting on M2? **1**

....

d) Calculate the acceleration of the trolley. **1**

....

Question 20 (2 marks)

A football player of mass 70 kg moving at 6 m/s east collides with a stationary player of mass 60 kg. The two have grabbed hold of each other and slide along a very wet and muddy playing field. At what velocity do they slide along? 2

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Question 21 (7 marks)

Not too long ago, manufacturers of baby capsules (seats for babies in cars) began to design a type which was made to be fastened 'backwards' on the back seat. In this way, the infant would *travel backwards* and face out the rear windshield.

a) Explain how this protects the baby better than a forward facing capsule. **2**

....

....

....

b) Why is it dangerous to leave loose objects in the back seat of the car? **1**

....

....

c) Name and describe one safety device in cars, which help protect people from injury. Include the concept of **stopping distance** in your response. **2**

....

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....

....

d) Use the equation $E = \frac{1}{2} mv^2$ to explain why a slight increase in speed (when moving fast) will make a big difference to stopping distance. **2**

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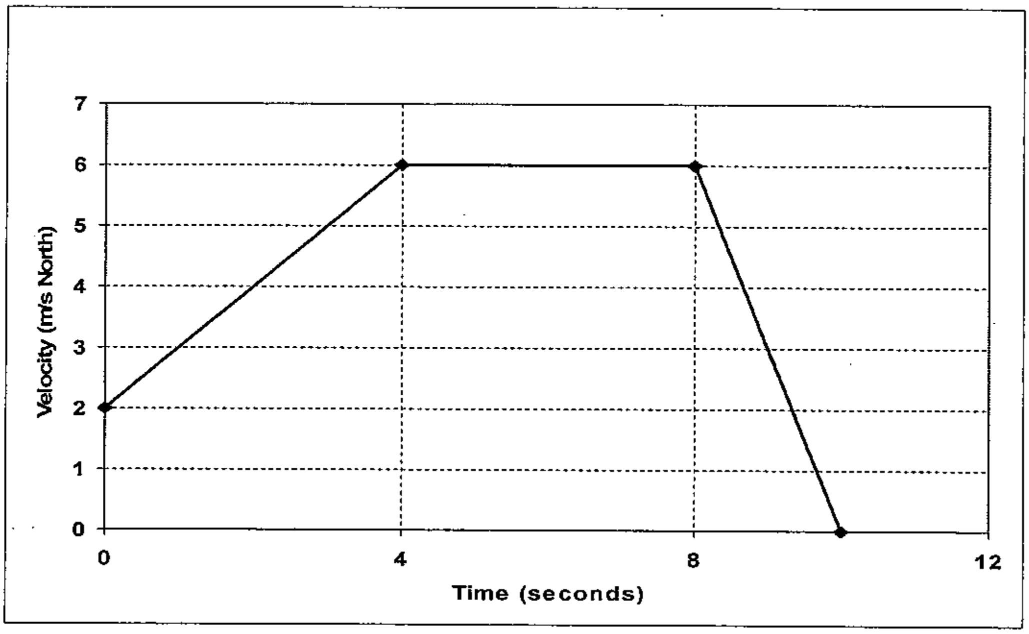
Question 22 (5 marks)

The following velocity vs time graph shows the motion of a motorbike over a period of 10 seconds.



a) Describe the motion from 4 to 8 seconds. 1

....

b) Compare the motion in the first 4 seconds to that in the last 2 seconds. 1

....

....

c) What is the average acceleration between 0 and 4 seconds? 1

....

....

d) What is the displacement of the motorbike after 8 seconds? 2

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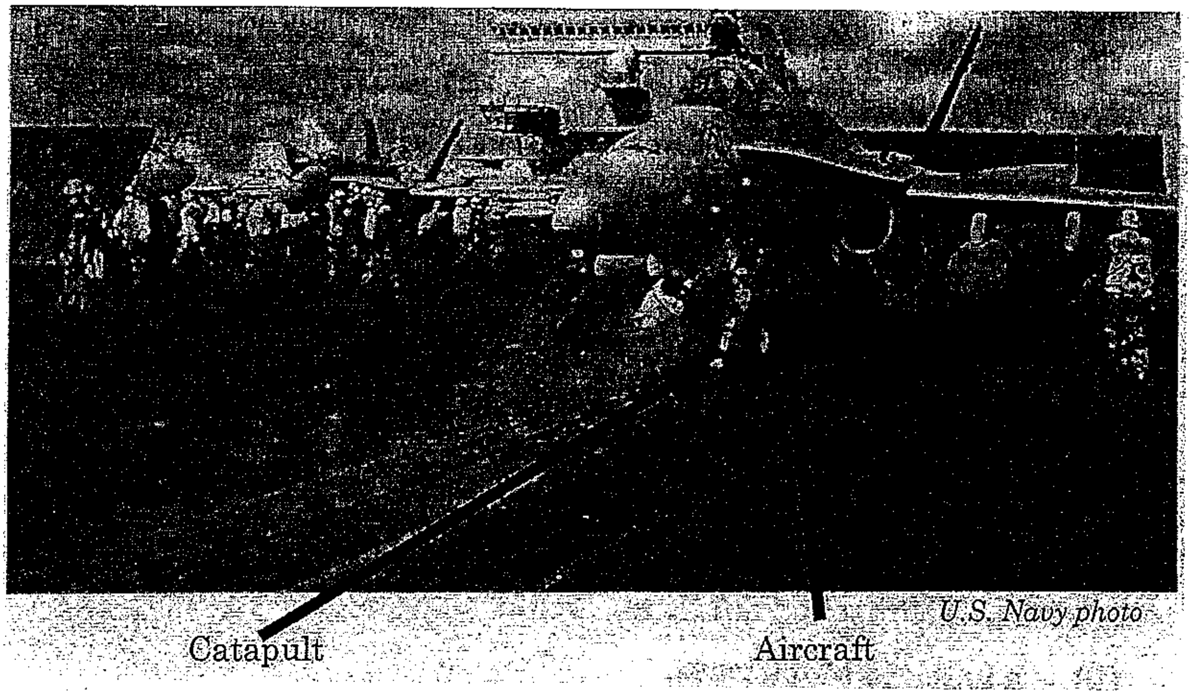
Question 23 (4 marks)

An aircraft of mass 25 000 kg taking off from an aircraft carrier at sea is accelerated from rest by means of a catapult, as shown in the photograph.



a) If the aircraft reaches a flight speed of 75 ms^{-1} from the catapult in 150m, determine the acceleration of the aircraft. 2

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b) How long does it take the aircraft to accelerate to its flight speed? 1

....

....

....

c) What is the average force applied by the catapult as it is accelerated? 1

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....

Question 24 (3 marks)

a) Outline the forces involved in causing a change in the velocity of a vehicle following a curve in the road. 1

....

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b) If the car enters the curve at 60km/hr North and exits at 80km/hr East, what is the change in velocity of the vehicle? 2

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Question 25 (5 marks)

Two trains are travelling on the same track. The freight train has a mass of 10 tonnes while the passenger train has a mass of 5 tonnes. The freight train is travelling East along the track at 20 ms-1. The passenger train is stationary. The trains collide and the freight train's final velocity is half of its original velocity.

a) What is the final velocity of the passenger train? **2**

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b) If the two trains were in contact for 0.4 seconds, what was the force that the passenger train applied to the freight train? **2**

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....

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c) What was the force that freight train applied to the passenger train. 1

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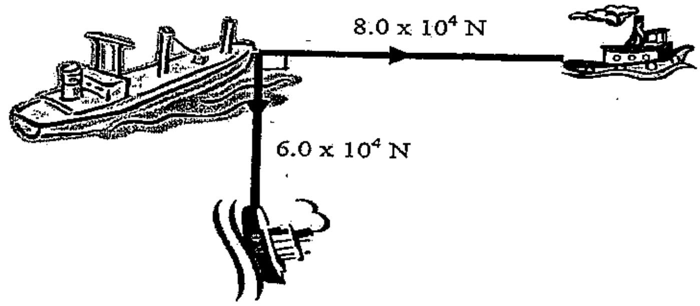
Question 26 (3 marks)

A motor bike moves in a straight line, accelerating uniformly at 3.0 m s^{-2} for 10.0 s, moving at a constant speed of 30.0 m s^{-1} for a further 20.0 s, and finally decelerating at a constant rate of 2.0 m s^{-2} until coming to rest. Draw a velocity-time graph for this motion. **3**

Question27 (3 marks)

A large ship has run aground on the Great Barrier Reef. Two tugboats are attempting to pull the ship off the reef. Their tow ropes are at an angle of 90° to each other. One rope has a tension force of 6.0×10^4 N and the other has 8.0×10^4 N, as shown.



Initially the ship remains stationary for the first two hours but then, when the tide comes up, the ship floats free and is observed to begin to accelerate at 0.020 m s^{-2} while the tugboats continue to pull.

a) Before being floated free, what is the net force acting on the ship? **2**

....

....

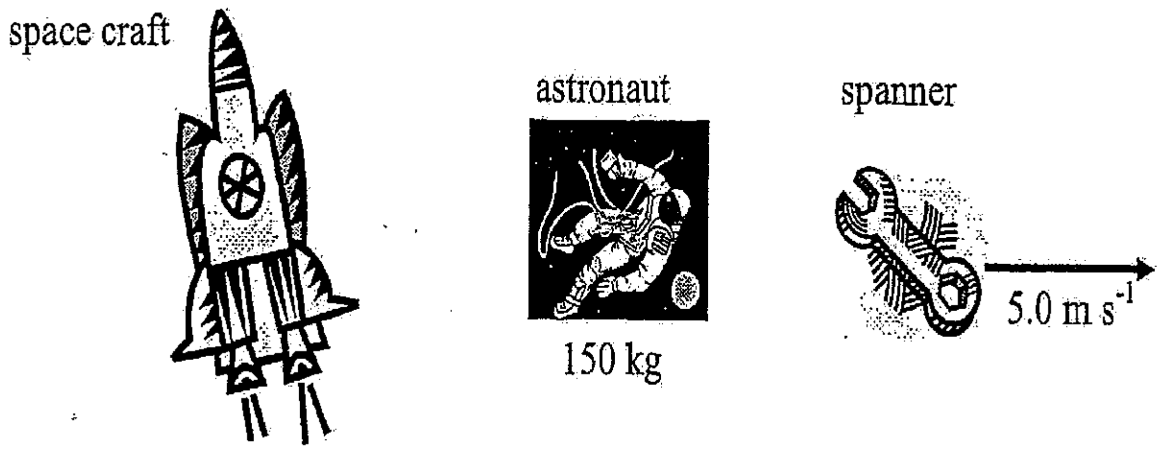
....

....

b) Calculate the mass of the ship (assume that there is no friction acting). **1**

Question 28 (4 marks)

An astronaut on a space walk loses her connecting rope that was tying her to the space craft. Without panic, she throws her 1.0 kg spanner away from the space craft with a speed of 5.0 m s^{-1}. The mass of the astronaut and her space suit is 150 kg.



Explain why the astronaut threw her spanner away. Use the numerical data in this question to help justify your answer. **4**

End of Paper

BHHS YR11 Half Yearly 2011
ANSWERS

1 A	6 C	11 D
2 B	7 C	12 B
3 C	8 C	13 D
4 D	9 A	14 B
5 C	10 A	15 C

Question 16 (2 marks) Marks

need to define the word "average"

Describe the difference between average speed and instantaneous speed? 2

Average speed is the total distance divided by the total time. Instantaneous speed is the speed at a particular time.

Just saying that Av speed is distance ÷ time does not distinguish from inst. speed

Question 17 (3 marks)

A man is walking east at 1.5 m/s, while a skateboard rider overtakes him travelling (in the same direction) at 7.5 m/s.

a) What is the relative velocity of the skateboarder with reference to the walker? 1

$V_{SB\ rel\ W} = V_{SB} - V_W$

$= 7.5 - 1.5$

$= 6.0\ ms^{-1}$ East

b) If a skateboard rider is travelling at 3 ms^{-1} North and the relative velocity of him to a walker is 4.24 ms^{-1} North West, find the velocity of the walker. 2

$V_{SB\ rel\ W} = V_{SB} - V_W$

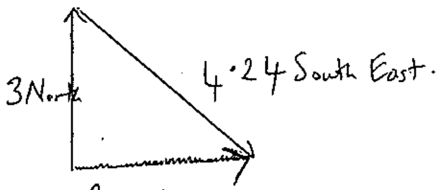
$4{\cdot}24\ NW = 3\ N - V_W$

$V_W = 3\ N - 4{\cdot}24\ NW$

$= 3\ N + 4{\cdot}24\ SE$

There must be enough working to show both magnitude and direction i.e. diag must be correct with arrowheads

Scale Diag:



Scale

$1\ cm = 1\ ms^{-1}$

(Alternative method cosine rule would give accurate answer)

$= V_W$

$= 3{\cdot}3\ ms^{-1}$ East

(Range of ± error acceptable)

Question 18 (4 marks)

A roofing tradie broke his ankle falling off a ladder from a height of 2.5m.

a) Calculate his final velocity before the ground stopped him from moving. 2

$u = 0\ ms^{-1}$

$v = ?\ ms^{-1}$

$a = -9.8\ ms^{-2}$

$r = -2.5\ m$

$v^2 = u^2 + 2ar$

$= 0^2 + 2(-9.8)(-2.5)$

$v^2 = 49$

$v = 7\ ms^{-1}$

b) Assume the tradie has a mass of 90 kg. Determine the kinetic energy (E_k) he gained in the fall. 1

$E_k = \frac{1}{2}mv^2 = \frac{1}{2} \times 90 \times 7^2$

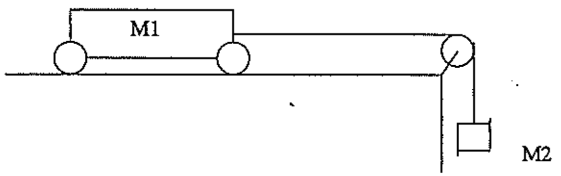
$= 2205\ J$

c) When he hit the ground, what has happened to the kinetic energy? 1

converted to heat energy and sound energy } both needed for the mark

Question 19 (4 marks)

Consider the following experiment:



Rounding for answers is OK but always use the full answer (non rounded) in the next calculation

a) How would you change M1 to increase the acceleration of the trolley? 1

↓ mass of M1

b) Assume M1 is 1.6 kg, and M2 is 0.2 kg. What is the total mass of the moving system? 1

$1{\cdot}6 + 0.2 = 1{\cdot}8\ kg$

c) Find the force of gravity acting on M2? 1

$F = mag = 0.2 \times 9.8 = 1{\cdot}96\ N$

d) Calculate the acceleration of the trolley. 1

$F = ma$

$1{\cdot}96 = 1{\cdot}8 \times a$

Note that 1.8 kg must be used in this calculation as the total mass is moving.

$a = 1{\cdot}09\ ms^{-2}$

Question 20 (2 marks)

A football player of mass 70 kg moving at 6 m/s east collides with a stationary player of mass 60 kg. The two have grabbed hold of each other and slide along a very wet and muddy playing field. At what velocity do they slide along? 2

Take East as positive

$p_i = p_f$

$m_1 u_1 + m_2 u_2 = (m_1 + m_2) V$

$70 \times 6 + 60 \times 0 = 130 \times V$

$V = 3 \cdot 23 \ ms^{-1}$ East (No mark just for direction)

1 mark + 1 mark

Question 21 (7 marks)

Not too long ago, manufacturers of baby capsules (seats for babies in cars) began to design a type which was made to be fastened 'backwards' on the back seat. In this way, the infant would *travel backwards* and face out the rear windshield.

a) Explain how this protects the baby better than a forward facing capsule. 2

mk) During a collision, the infant's body and head will be pressed back onto the capsule with the force of impact evenly distributed/ reduced. There would no whiplash as ~~could~~ experienced occur in a forward

1mk) facing capsule.

b) Why is it dangerous to leave loose objects in the back seat of the car? 1

when a moving vehicle slows down / stops suddenly, loose objects due to their inertia, will continue to travel forward with the velocity the vehicle was travelling ~~before~~ before it stopped.

c) Name and describe one safety device in cars, which help protect people from injury. Include the concept of **stopping distance** in your response. 2

1mk A good description of ~~the~~ how the named safety device work. Must explain quantitatively the link between the

1mk force involved with the stopping distance

d) Use the equation $E = \frac{1}{2} mv^2$ to explain why a slight increase in speed (when moving fast) will make a big difference to stopping distance. 2

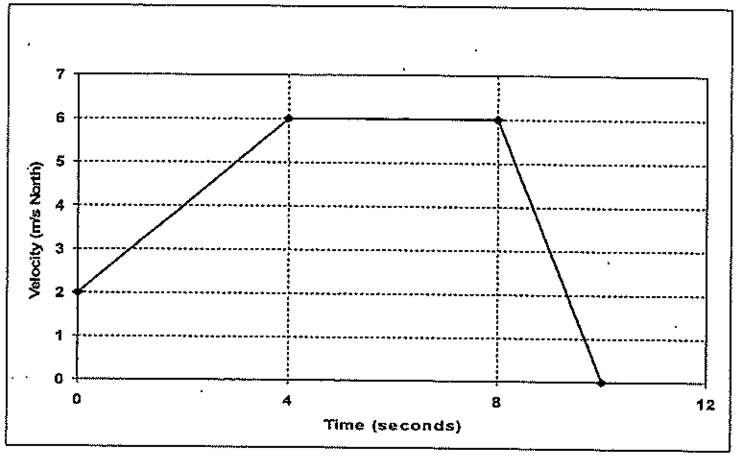
1mark) A force is applied to the brakes to stop a moving vehicle. Thus the workdone by the force brings about a change in ~~the~~ kinetic energy. ie. $Fr = \Delta KE$. $(Fr = \frac{1}{2}mv^2 - \frac{1}{2}mu^2)$

As $KE = \frac{1}{2}mv^2$ and the force applied is constant,

mark) then $r \propto v^2$ (ie. when the velocity is doubled, the stopping distance, r, will be increased by four times.

Question 22 (5 marks)

The following velocity vs time graph shows the motion of a motorbike over a period of 10 seconds.



a) Describe the motion from 4 to 8 seconds. 1

The motorbike was travelling at a constant velocity of $6 ms^{-1}$ N

b) Compare the motion in the first 4 seconds to that in the last 2 seconds. 1

In the first 4s, the motorbike accelerated at a slower rate than the deceleration during the last 2s.

c) What is the average acceleration between 0 and 4 seconds? 1

$a = \frac{6-2}{4-0} = 1.0 \ ms^{-2}$ N

d) What is the displacement of the motorbike after 8 seconds? 2

$s = [\frac{1}{2}(2+6) \times 4] + (8-4)(6)$

$= 16 + 24$

$= 40m$ N

show working
Correct value
unit
2 mk.

show working
unit
1 mk

Question 23 (4 marks)

An aircraft of mass 25 000 kg taking off from an aircraft carrier at sea is accelerated from rest by means of a catapult, as shown in the photograph.

a) If the aircraft reaches a flight speed of 75 ms^{-1} from the catapult in 150m, determine the acceleration of the aircraft. 2

$v^2 - u^2 = 2as$

$\therefore a = \frac{(75)^2 - 0}{2 \times 150}$

$= 18.75 ms^{-2}$ forward

correct working, unit } 2mks

b) How long does it take the aircraft to accelerate to its flight speed? 1

$v = u + at$

$t = \frac{75 - 0}{18.75} = 4.0 s$

c) What is the average force applied by the catapult as it is accelerated? 1

$F_{net} = ma$

$\therefore F_{average} = (25{,}000 \times 18.75)$

$= 468750 N$

$= 4.7 \times 10^5 N$

Question 24 (3 marks)

a) Outline the forces involved in causing a change in the velocity of a vehicle following a curve in the road. 1

Friction between tyres and road to turn corner, or, centripetal force

b) If the car enters the curve at 60km/hr North and exits at 80km/hr East, what is the change in velocity of the vehicle? 2

$\delta vel = 80 kph E - 60 kph N$

$= 80 kph E + 60 kph S$

$\tan\theta = \frac{60}{80} = 0.75$

80kph, 60kph, x, θ

$x = 100 kph$ ... 1 mk.

$\theta = 36.87^\circ$ S of E ... 1 mk.

Question 25 (5 marks)

Two trains are travelling on the same track. The freight train has a mass of 10 tonnes while the passenger train has a mass of 5 tonnes. The freight train is travelling East along the track at 20 ms-1. The passenger train is stationary. The trains collide and the freight train's final velocity is half of its original velocity.

a) What is the final velocity of the passenger train? 2

Initial momentum $= 10 \times 20 = 200 t.m/s$ E (TOTAL)

Final momentum of freight train $= 10 \times 10 = 100 t m/s$ E

$\therefore$ " " of pass train $= 100 t m/s$ E

$\therefore$ " velocity $= \frac{100}{5} = 20 m/s$ E ← 1 mk.

← 1 mk

b) If the two trains were in contact for 0.4 seconds, what was the force that the passenger train applied to the freight train? 2

$I = Ft$ δp freight train $= 10 \times 10^3 \times 10$ Ns W

$F = \frac{I}{t} = \frac{10 \times 10^3 \times 10}{0.4}$

$= 250\,000 N$ W ← 1 mk.

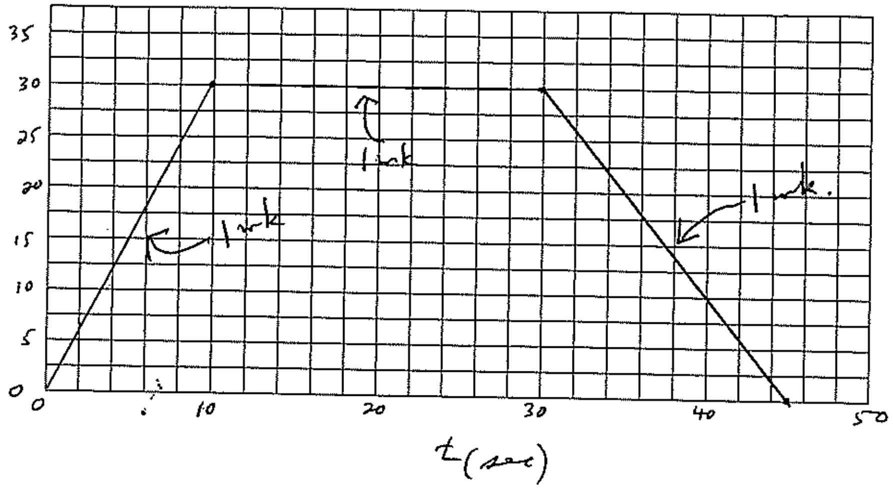
← 1 mk

c) What was the force that freight train applied to the passenger train. 1

$F = 250000 N$ E

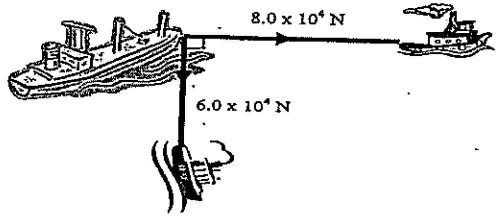
Question 26 (3 marks)

A motor bike moves in a straight line, accelerating uniformly at 3.0 m s^{-2} for 10.0 s, moving at a constant speed of 30.0 m s^{-1} for a further 20.0 s, and finally decelerating at a constant rate of 2.0 m s^{-2} until coming to rest. Draw a velocity-time graph for this motion. 3



Question27 (3 marks)

A large ship has run aground on the Great Barrier Reef. Two tugboats are attempting to pull the ship off the reef. Their tow ropes are at an angle of 90° to each other. One rope has a tension force of 6.0×10^4 N and the other has 8.0×10^4 N, as shown.



Initially the ship remains stationary for the first two hours but then, when the tide comes up, the ship floats free and is observed to begin to accelerate at 0.020 m s^{-2} while the tugboats continue to pull.

a) Before being floated free, what is the net force acting on the ship? 2

Either: 0 (with explanation)

Or: 8×10^4, 6×10^4, θ — $x^2 = (8\times10^4)^2 + (6\times10^4)^2$

$x = 1\times10^5$ N ------- 1 mk

$\tan\theta = \frac{6}{8} = 0.75$ $\theta = 36.87°$

b) Calculate the mass of the ship (assume that there is no friction acting). 1

$F = ma$

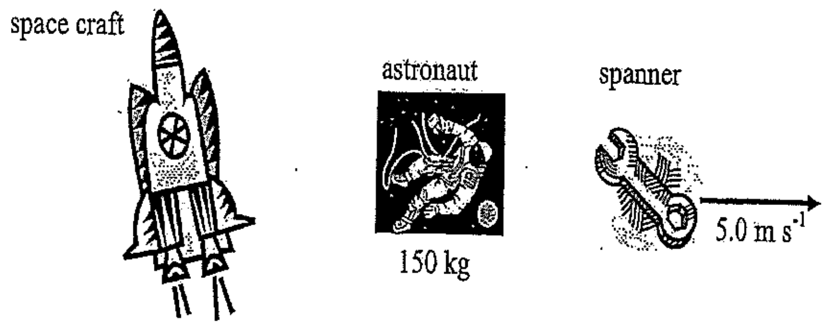
$1\times10^5 = m \times 0.02$

$m = \frac{1\times10^5}{0.02}$

$m = 5000000$ kg

Question 28 (4 marks)

An astronaut on a space walk loses her connecting rope that was tying her to the space craft. Without panic, she throws her 1.0 kg spanner away from the space craft with a speed of 5.0 m s^{-1}. The mass of the astronaut and her space suit is 150 kg.



Explain why the astronaut threw her spanner away. Use the numerical data in this question to help justify your answer. 4

* Newton's 3rd Law OR conservation of momentum.
* Spanner thrown away from rocket.
* Astronaut moves in opposite direction
* Momentum of spanner = − momentum of astronaut, so $1\times5 = 150\times$vel
vel astronaut = − 0.03 m/s

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