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91171

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SUPERVISOR'S USE ONLY

Level 2 Physics, 2015

91171 Demonstrate understanding of mechanics

9.30 a.m. Tuesday 17 November 2015
Credits: Six

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of mechanics.	Demonstrate in-depth understanding of mechanics.	Demonstrate comprehensive understanding of mechanics.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Make sure that you have Resource Sheet L2–PHYSR.

In your answers use clear numerical working, words and/or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

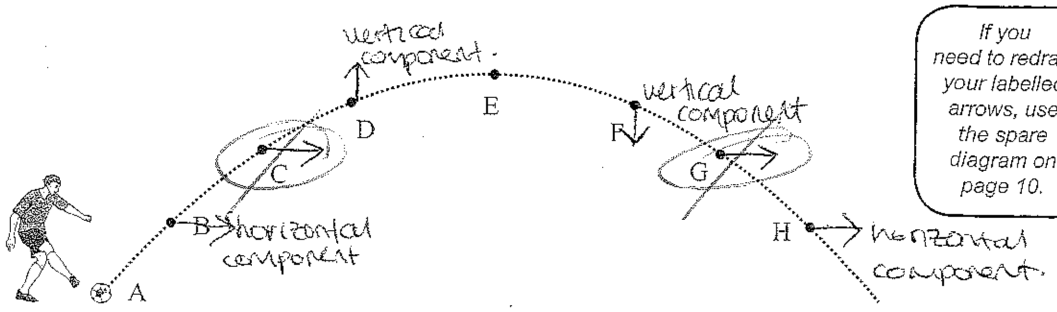
Not Achieved

TOTAL 7

ASSESSOR'S USE ONLY

QUESTION ONE: PROJECTILES

Roy kicks a ball. The diagram below shows the trajectory of the ball. You may assume air resistance to be negligible.

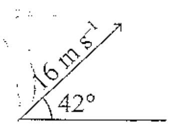


If you need to redraw your labelled arrows, use the spare diagram on page 10.

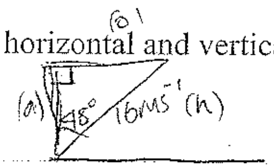
(a) On the diagram draw **labelled arrows** of **appropriate length** to show the following:

- the force on the ball at position C and at position G
- the horizontal component of the velocity of the ball at position B and at position H
- the vertical component of the velocity of the ball at position D and at position F.

(b) The ball is kicked with an initial velocity of 16 m s^{-1}, at an angle of 42° to the ground.



Calculate the initial horizontal and vertical components of the velocity of the ball at position A.



$V_i = 16ms^{-1}$

$\alpha = 42°$ = cos 48 × 16 = sin 48 × 16

= 12ms^{-1} = 12ms^{-1}

(c) State the horizontal and vertical components of the velocity of the ball at position E. Explain your answers.

The horizontal components of the velocity of the ball at postion E is 0ms^{-1} as it is at the top and is moving from deceleration to acceleration. The vertical component is 12ms^{-1} as it is constant throughout the whole journey assuming that there are no external forces acting on it.

(d) Calculate the horizontal distance the ball travels before returning to the level from which it was kicked.

~~$v_f = 16ms^{-1}$~~ $a = \frac{\Delta v}{\Delta t}$

$V_f = 0ms^{-1}$ ~~$t = a \div v$~~

~~$v_i = 16ms^{-1}$~~ ~~$= 16$~~

$V_i = 16ms^{-1}$

~~$a = 16ms^{-2}$~~

$a = 16ms^{-2}$

ASSESSOR'S USE ONLY

na

N1

QUESTION TWO: ICE SKATING

ASSESSOR'S USE ONLY

Janet and Roy are ice skating.

(a) At one point, Roy is standing still, and Janet glides up to him from behind and grabs him by the shoulders. Janet's velocity as she glides up to Roy is 5.0 m s^{-1}, and together they glide off at a velocity of 2.2 m s^{-1} in the same direction as Janet was gliding (assume that both Janet's and Roy's skates are pointing in the direction of travel). Roy has a mass of 65 kg.

http://sport-kid.net/ice-skating-fall-couple.html

(i) State the law of physics that applies to this situation.

Newtons 1st Law of inertia.

a

(ii) Calculate Janet's mass.

Roy: $V_i = 0 ms^{-1}$
$V_f = 2.2 ms^{-1}$
$m = 65 kg$

Janet: $V_i = 5.0 ms^{-1}$
$V_f = 2.2 ms^{-1}$
$m = ?$

$a = -2.8 ms^{-2}$

na

(iii) Explain why you can use the assumptions you made when calculating Janet's mass.

na

After removing her skates, Janet jumps down to the ground from a high bench.

ASSESSOR'S USE ONLY

(b) Write a comprehensive explanation of what Janet needs to do while landing, so that she does not hurt herself.

Use a formula to explain your answer.

Janet needs to bend her knees while bending, so that she does not hurt herself. This is because it increases the time. This is important as the ground shock she would feel if she didnt bend here knees is a force because every force has an equal and opposite reaction. F=ma and a = ∆v/∆t so the more time there is the less acceleration and the less acceleration there is the less force.

M

(c) When Janet jumps down, is her momentum conserved?

Explain.

Janets momentum is conserved until she hits the ground. This is because her momentum isn't acting on something so when she hits the ground it is no longer conserved.

Na

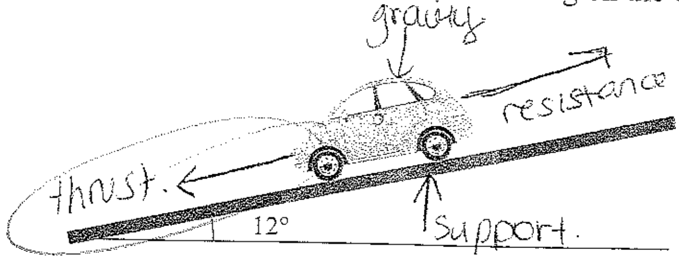
A3

QUESTION THREE: JANET'S CAR AND SPRINGS

ASSESSOR'S USE ONLY

Janet arrives home. She parks the car on a slope that is at 12° to the horizontal, as shown in the diagram below.

(a) Draw **labelled arrows** to show the **individual forces** acting on the car.



If you need to redraw your labelled arrows, use the spare diagram on page 10.

a

(b) Explain in terms of forces acting on the car, how the car remains stationary on the slope.

You may draw a vector diagram to help your explanation.

The car remains stationary on the slope because the resistance force is greater than the thrust and the support is greater than gravity.

n2

ASSESSOR'S USE ONLY

(c) The mass of the car is 1500 kg.

Carry out calculations to show how forces keep the car stationary while it is parked on the slope.

You may draw a vector diagram to help your calculation.

~~m=1500kg~~ F=ma. A force on a car can be shown through this formulae

F=ma

F = 1500x0.

= 1500N.

Because there is no acceleration the force the force will be smaller.

na

(d) The sofa in Janet and Roy's house has springs. When Roy sits on the sofa, the springs compress by 0.075 m.

Calculate the elastic potential energy stored in the springs. (Roy has a mass of 65 kg.)

~~Ep~~ $\Delta E_p = mg\Delta h$.

m=65kg.

h=0.75m. = 65 x 9.8 x 0.7

g=9.8ms⁻². = 445Nm.

na

N1

QUESTION FOUR: CIRCULAR MOTION AND TORQUES

ASSESSOR'S USE ONLY

(a) Janet swings a ball tied on a string in a horizontal circle above her head.

Explain why the ball is accelerating even though it is swinging at constant speed.

http://www.shutterstock.com

The ball is accelerating even though it is swinging at a constant speed because of the change in direction. ~~the speed~~ and time. Acceleration keeps changing because the time is changing $(A = \frac{\Delta v}{\Delta t})$. Where as velocity doesn't change because the distance is the same for every circle. ~~So~~

(b) The length of the string is 0.75 m. It takes 0.84 seconds for the ball to go around her head once.

Calculate the acceleration of the ball.

$d = 0.75 m$

$t = 0.84 seconds$

$a = ?$

$v = 0.89 ms^{-1}$

$v = \frac{d}{t} = \frac{0.75}{0.84} = 0.89 ms^{-1}$

$a = \frac{\Delta v}{\Delta t} = \frac{0.89}{0.84} = 1.1 ms^{-2}$

ASSESSOR'S USE ONLY

(c) Name the force that causes the ball to accelerate as it goes in a circle.

Explain why the force causes the ball to accelerate.

Centripetal force is what causes the ball to accelerate as it goes in a circle. This causes the ball to accelerate because it is resisting the ball from moving in a constant direction and making it gain momentum throughout a circle.

a

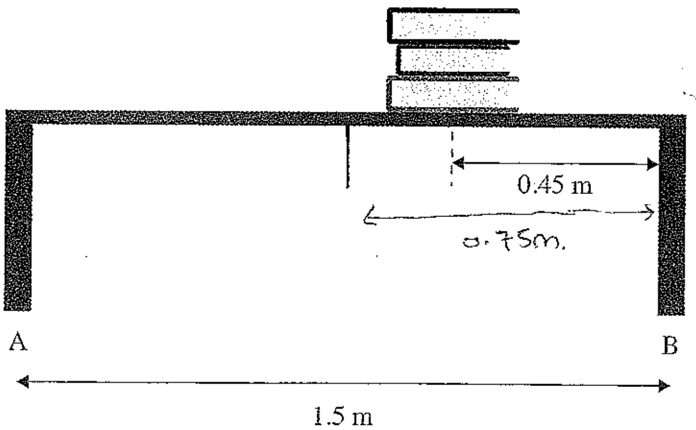
(d) Janet's study table has two panels, one at each end. Janet has a pile of books on her table.

Use the details given below to calculate the support force provided by panel A of the study table.

Mass of table	= 37 kg
Length of table	= 1.5 m
Mass of books	= 7.4 kg

The weight of the books acts at a distance of 0.45 m from end B of the table.

Assume Janet's study table is uniform.



F=mg
= 7.4×9.8
= 75.52N

τ = 75.52N × 0.45
= 33.9

τ = 33.9

τ = τ

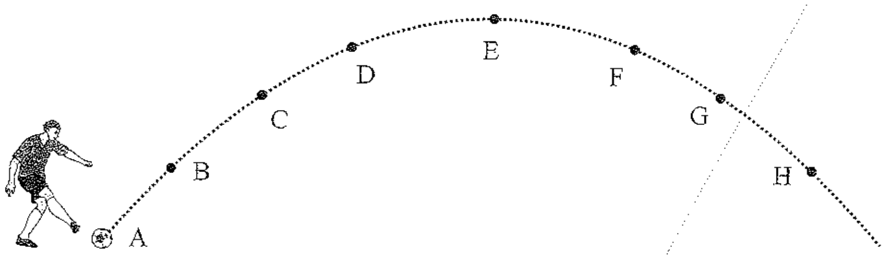
N0

N2

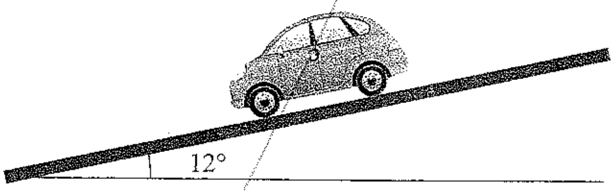
SPARE DIAGRAMS

ASSESSOR'S USE ONLY

If you need to redraw your labelled arrows on the diagram from Question One (a), draw them on the diagram below. Make sure it is clear which diagram you want marked.



If you need to redraw your labelled arrows on the diagram from Question Three (a), draw them on the diagram below. Make sure it is clear which diagram you want marked.



Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

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Not Achieved exemplar for 91171 2015			Total score	07
Q	**Grade score**	**Annotation**		
1	N1	This response does not meet the requirements for Achievement. While the candidate demonstrates some understanding of the velocity of a projectile, calculations prove too challenging. In the attempt to explain vertical and horizontal components of projectile motion, the terms ‘vertical’ and ‘horizontal’ appear confused		
2	A3	The candidate shows some evidence of Achievement in this response, providing a reasoned, if incomplete, explanation of a situation involving the concept of impulse. However, there is no evidence of the ability to apply knowledge to problem solving		
3	N1	There is no evidence in this response that the candidate meets the requirements for Achievement. Both calculations are either incorrect. Two of the three free body forces are correctly drawn but the explanation of equilibrium shows no understanding of forces and their relation to motion		
4	N2	The candidate shows insufficient evidence for Achievement. Some understanding is demonstrated in the explanatory parts of the question. Both steps in the first numerical part are attempted, but incorrect formulae are applied. A further attempt is made correctly to begin the second numerical part, but this is not followed through		