1

SUPERVISOR'S USE ONLY

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Science, 2011

90940 Demonstrate understanding of aspects of mechanics

9.30 am Monday 21 November 2011
Credits: Four

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

Show ALL working.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–13 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 10

ASSESSOR'S USE ONLY

You are advised to spend 60 minutes answering the questions in this booklet.

ASSESSOR'S USE ONLY

QUESTION ONE: PARACHUTING

A parachutist of mass 75 kg jumps from a plane at a height of 4 000 m above sea level.

(a) The parachutist falls through a distance of 2 400 m during the first 60 seconds. Calculate the average speed of the parachutist during this time.

$V = \frac{d}{t}$

2400 ÷ 60 = 40

Average speed = 40 m s⁻¹

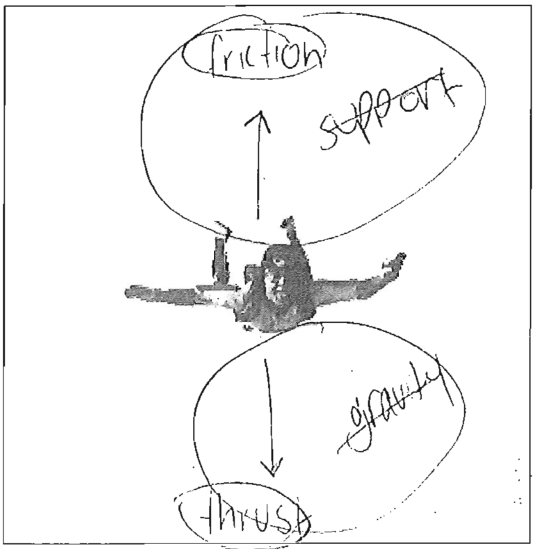
For copyright reasons, this image has not been reproduced here.

http://riverdaughter.files.wordpress.com/2009/07/free-fall1.jpg

(b) Ex... ...tical motion of the parachutist **jus...** ...fore the pa...

In... g on ...zes ...chutist ...cts the

40 ms⁻¹ = 1 A point
accepted balanced forces
& constant speed because
this is case after ≈ 6 sec
& we considered up to
60 seconds timeline
ie (before the parachute opens)
The would be merit point
except term thrust is not
correct for weight force.
So only a 1 A point
for balanced forces / (and
force body diagram good too)



The net vertical force is balanced and the vertical motion of the parachutist is that she is moving down wards at a constant speed. The fact that the thrust and friction are balanced means that she will move at a constant speed wheras if her thrust was greater than friction she would be gaining speed.

ASSESSOR'S USE ONLY

(c) After the 60 seconds, the parachutist pulls the cord and opens her parachute.

Explain how the parachute reduces the speed of the parachutist when it is just opened.

In your answer you should consider:

- how the motion of the parachutist changes when the parachute is opened
- the effect of the size of the parachute on the motion
- the effect of the parachute on the net vertical force.

For copyright reasons, this image has not been reproduced here.

http://www.wallpaper-free.eu/wallpapers/parachute/parachute001_1400x1050.jpg

The parachute will reduce the speed of the parachutist because now there is more friction holding her back. When the parachute opens the vertical motion decreases in speed if the parachute is larger ~~then~~ then there will be a greater force holding her back. Now that there is more friction than thrust the net vertical force becomes unbalanced and therefore reduces the speed of the parachutist.

Box being
Box becomes unbalanced
= 1 A Point
No mention of resultant
or net force
So 3 A Points = A4

A4

QUESTION TWO: RUNNING

ASSESSOR'S USE ONLY

A boy runs along a track, as shown above.

During section X, he runs with a **constant speed** of 2 m s^{-1} for 15 seconds.

During section Y, he runs with a **constant acceleration** of 0.2 m s^{-2}.

(a) Calculate the net force acting on the boy (mass 60 kg) during **section Y**.

Give an appropriate unit with your answer.

Fnet = Mass x acceleration

60 x 0.2 = 12

Net force acting on the boy during section Y = 12 (N unit)

(b) The boy runs 12.5 m during section Y in 5 seconds.

Calculate the power required by the boy to produce the constant acceleration of 0.2 m s^{-2} in 5 seconds during section Y.

Give an appropriate unit with your answer.

P = F / a

12 ÷ 0.2 = 60

Power required by the boy during section Y = 60 (W unit)

ASSESSOR'S USE ONLY

(c) (i) Calculate the speed of the boy as he reaches the end of section Y.

$V = \frac{d}{t}$

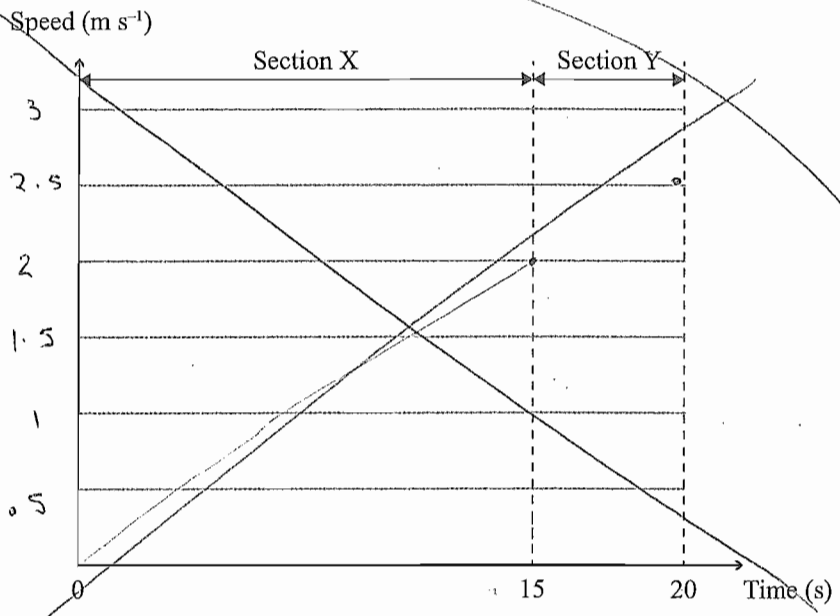
$12.5m \div 5 = 2.5$

Speed at the end of section Y = 2.5 m s^{-1}

(ii) Use this and the other information provided in the question to complete the speed/time graph below.

On your graph, you should:

- label the speed values on the vertical axis
- draw a line on the graph to show the speeds for section X **and** section Y.

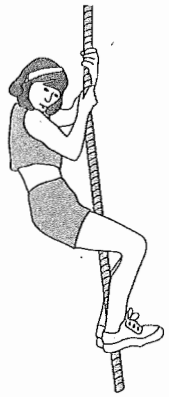


If you need to redraw this graph, use the grid on page 12.

See graph on page 12.

QUESTION THREE: ROPE CLIMBING

ASSESSOR'S USE ONLY



A girl of mass 60 kg uses 5 100 J of energy when she climbs a vertical rope.

(a) Calculate the maximum height it would be possible for the girl to reach.

mg ÷ Ep = h
60kg x 10 ÷ 5100 = 0.11

(b) In reality, the girl reaches a height of only 8 m.

Explain why the **energy** used by the girl during the climb does **not** equal the work she does to reach the vertical height of 8 m.

In your answer you should:

- name the type of energy the girl has when she is 8 m above the ground
- calculate the work done to reach a height of 8 m above the ground
- calculate the difference between the work done and the energy used by the girl
- explain where the "missing" energy has gone, and why this occurs.

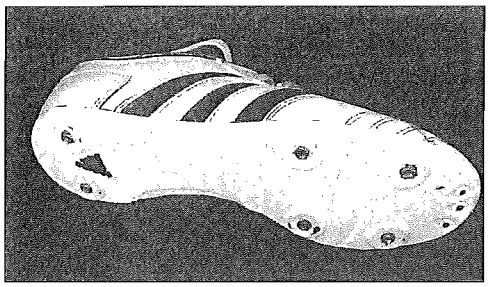
When the girl is 8m above ground the energy she has is potential energy. To reach the 8 metres work done = 80 (W = 10 x 8). The difference between the energy of the girl and the work done is that the energy used is how much her body has used while the work done is what she has done physically.

(b) Missed word at "gravitational".
no calc of work done or Energy Difference
no mention of heat produced
no metric Ref
Ep = W.
So N1 for attempting to use Ep = mgh.
for (3)

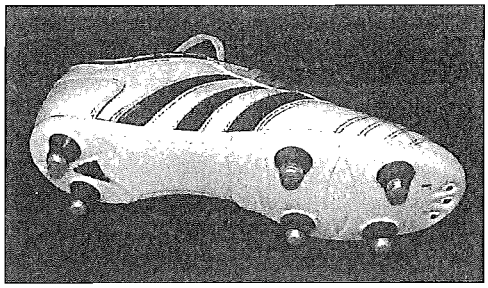
ASSESSOR'S USE ONLY

QUESTION FOUR: FOOTBALL BOOTS

ASSESSOR'S USE ONLY



Boot **without** studs.



Boot **with** studs.

A student of mass 40 kg uses the football boots shown above.

ONE boot **without** studs has a surface area of 165 cm^2 (0.0165 m^2) in **contact** with the ground.

ONE boot **with** six studs has a surface area of only 6 cm^2 (0.0006 m^2) in **contact** with the ground.

(a) Calculate the pressure exerted if the student stands on ONE foot on a **hard surface**, for the boot **without** studs AND for the boot **with** studs.

Give an appropriate unit ~~with your answers~~.

(i) Without studs: $p = m \div a$

$40\text{kg} \div 165 = 0.24$

Pressure exerted by ONE foot for the boot **without** studs = 0.24 (2dp) (kg unit)

(ii) With studs: $p = m \div a$

$40\text{kg} \div 6 = 6.66$

Pressure exerted by ONE foot for the boot **with** studs = 6.66 (2dp) (kg unit)

(b) Discuss the **advantage** gained by the student when running on a **soft grass** football field while wearing the boots with studs **compared** to wearing boots of the same size without studs.

ASSESSOR'S USE ONLY

In your answer you should:

- compare the pressure exerted on the ground by the boot with the studs AND the boot without studs
- explain the relationship between surface area and pressure exerted
- explain how the difference in pressures would help the student run on a softer surface like grass.

The boot with studs exerts more pressure on the ground compared to the boot without studs. The smaller the surface area, the more pressure exerted because ~~the weight~~ there is more weight or the ~~stress~~ boot with a smaller surface area however if the boot has a larger surface area then the weight is more distributed causing there to be less pressure exerted. When the student is wearing the boots with studs the advantage is that it will be easier for him to run on the soft grass because he would not sink as much.

studs: more pressure because of less area
: correct pressure comparison
= 1 A point
so 2 A points = A3

A2

If you need to redraw the graph from Question Two (c), draw it on the grid below. Make sure it is clear which graph you want marked.

ASSESSOR'S USE ONLY