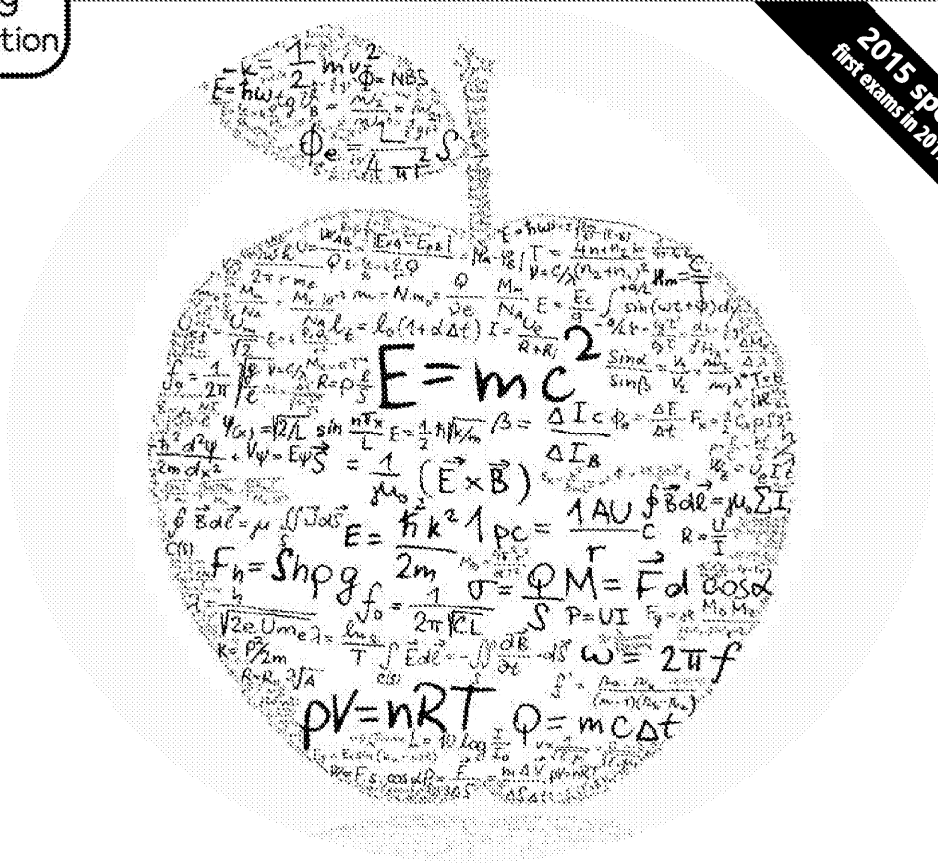
Physics AS and A Level | OCR A | H156 and H556

2015 specification
first exams in 2017 (2016 for AS)



Topic Tests

for AS and A Level Year 1 OCR Physics A Modules 2, 3 and 4

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POD 6628

Contents

Teacher's Introduction

These topic tests have been designed to help you and your students assess their knowledge of a topic after you have taught each section of **AS and A Level Year 1 OCR Physics A Modules 2–4.**

Each topic test closely follows the content of the specification and includes:

- **Factual questions**: Some simpler factual questions are included to ensure that all the content and basics are covered, and to allow weaker learners access to some marks.
- **Short-answer questions**: These are not in exam style, and the purpose of these is to test different elements, knowledge and skills from the specification in a variety of styles.
- **Exam-style questions**: Where appropriate, topics may contain one or more exam-style questions, to prepare students for what they might meet in the exam, and to test exam skills.

Mathematical and practical skills are also covered in these topic tests.

Tests have been designed to take approximately 25–60 minutes and most are worth on average between 25 and 40 marks. Please note that some tests are shorter and others have been combined where appropriate, as shown in the table.

Topic Number	Marks
Module 2	
2.1.1 and 2.1.2	37
2.2.1 (i)	17
2.2.1 (ii)	24
2.3.1	27
Module 3	
3.1.1	35
3.1.2	36
3.1.3	31
3.2.1	41
3.2.2	27
3.2.3/3.2.4	36
3.3.1/3.3.2/3.3.3	40
3.4.1/3.4.2	40
3.5.1/3.5.2	38
Module 4	
4.1	33
4.2	41
4.3.1	33
4.3.2/4.3.3	38
4.4.1	33
4.4.2	35
4.4.3	28
4.4.4	24
4.5	39

The topic tests are suitable for a classroom assessment, revision aid or homework task and are, therefore, suitable for use immediately after a topic is completed in class or at the end of teaching the course.

Students are able to see the number of marks awarded for each question, allowing them to gauge the level of detail they will require for the answers, as in exam conditions. Full answers are included at the end of the resource and are accompanied by marker instructions, providing quick guidelines on what answers would and would not be accepted in an exam situation. Additionally, it makes the resource a suitable tool for students to use independently.

All diagrams and graphs have been designed with black-and-white photocopying in mind, so key features will not be lost.

Students will need a **calculator**, **graph paper** and **ruler** to complete the questions.

Students may also need a sheet containing Physics data and formulae, which can be found on the exam board website.

I hope you find these tests useful during your teaching.

3.1.1 Kinematics

1. Define the term *displacement.*

2. Define the term *average speed.*

3. Define the term *instantaneous speed.*

4. State the key difference between velocity and speed. State the units fo

5. Indicate whether the following two situations are describing either ins average speed.

   a) During a flight from London to Edinburgh, ground control radios what the [illegible] speed is at 5 minutes before land time.

   b) The parents of a new university student drive down with the stud They travel around 150 miles from their home to the university ha know how fast they were travelling if it took them 2½ hours to co

6. A student travels by bus to get to school. The school is 3.5 km from he travels at a velocity of 13.4 ms^{-1}. Calculate how long it will take the s

7. a) Define the term *acceleration.*

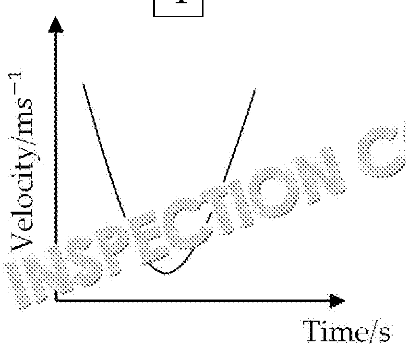
   b) Calculate the acceleration of a motor bike if its velocity changes a every 2 seconds.

8. Indicate which graph could be used to calculate the following quantiti your answer.

   a) Acceleration

   b) Distance

1



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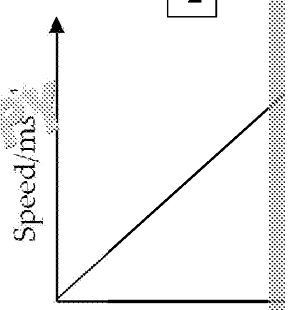
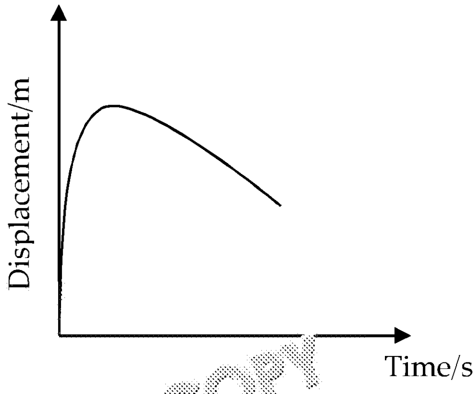
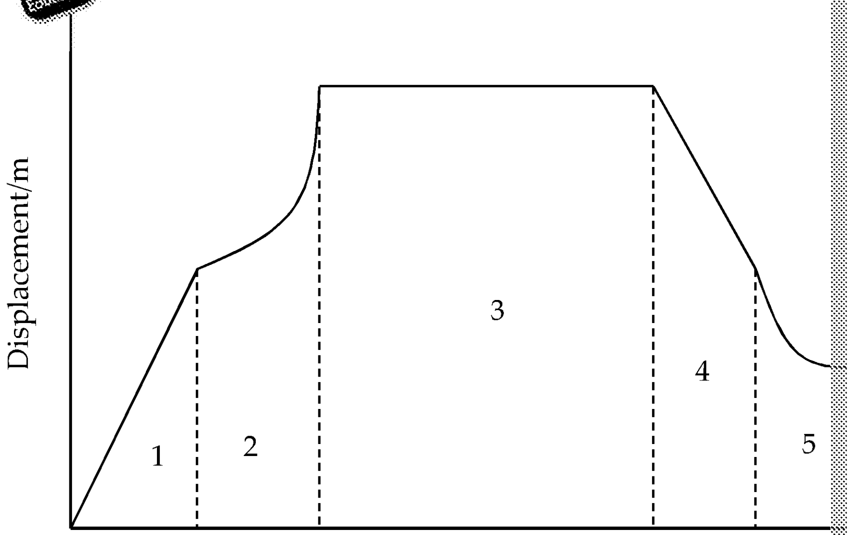


c) Explain how you could calculate velocity from the following disp

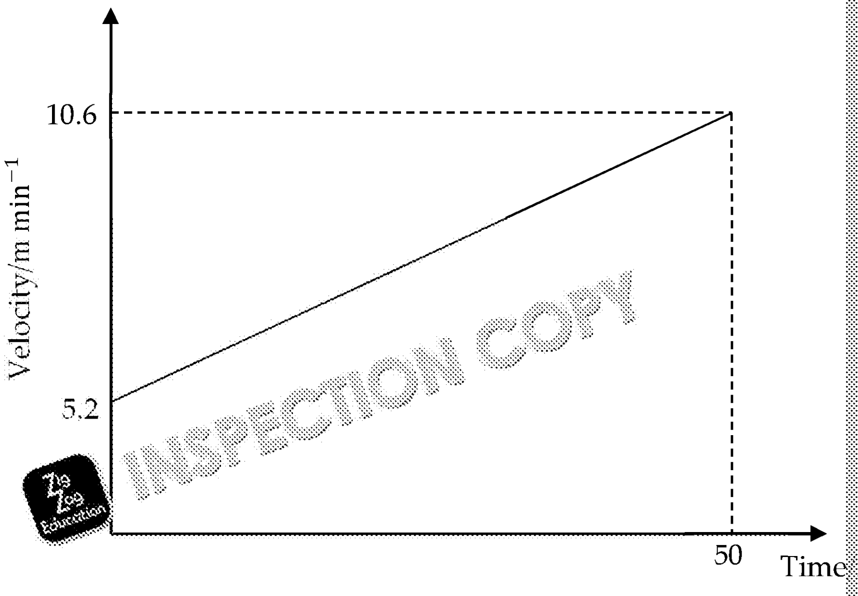


9. The motion of a rally car was recorded during its race and the followi was plotted.



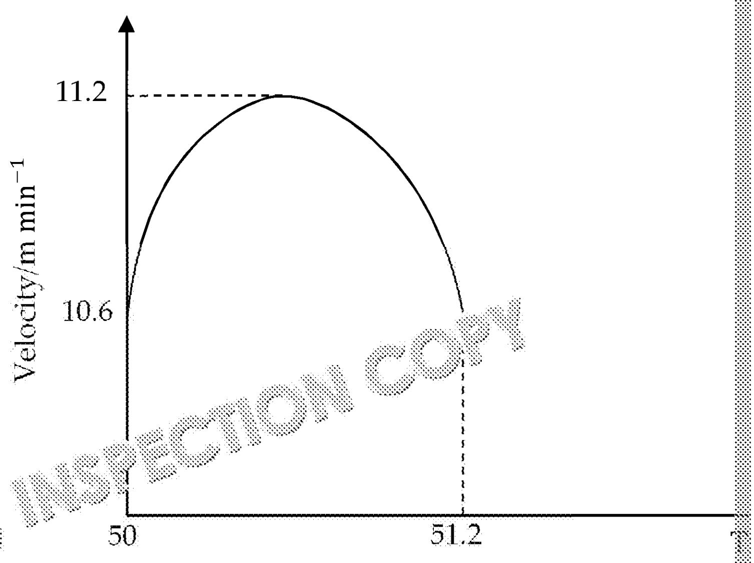
a) Describe the car's motion at each stage of the car's journey.
b) Sketch a velocity–time graph for stage 2 of the car's journey.
c) Explain how you could determine the instantaneous acceleration and therefore state the difference in determining the average acce

10. A joggerrecords his motion during the first section of a marathon. He
changes during the first 50 minutes of the race.



a) State velocity that the jogger initially records himself at.
b) Calculate the jogger's acceleration.
c) Explain the effect on the jogger's acceleration if the time he took t
section increased, with the jogger's initial and final velocities rem

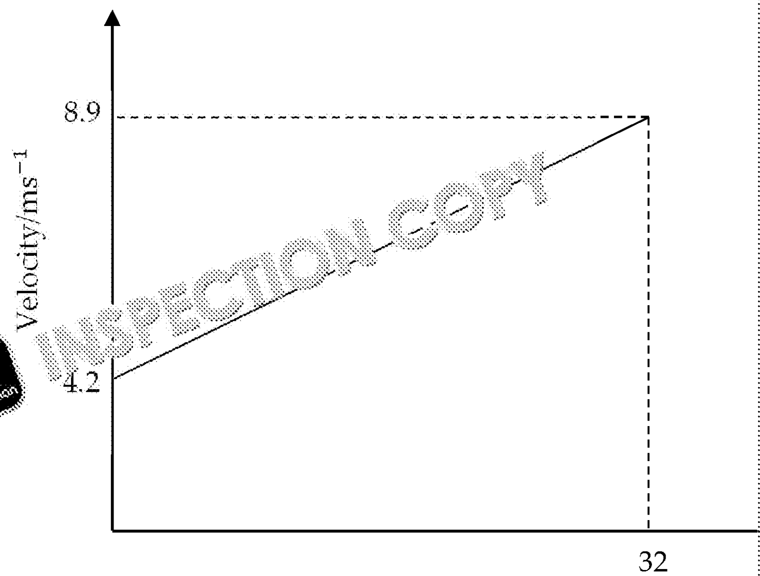
The motion of the jogger alters in the next 50 minutes of the race. The
described by a velocity–time graph.



d) Estimate the displacement of the jogger during this section of the
Hint: Approximate the parabola as a semicircle.

3.1.2 Linear Motion

1. The transport department of the local council has been recording the r outside local primary and secondary schools to understand whether s met. The motion of one vehicle is described in the velocity–time graph.



   a) What relationship does the graph illustrate?
   b) Explain how the department could use their knowledge of the equ $y = mx + c$, to determine the vehicle's initial velocity and acceler
   c) State the vehicle's initial velocity.
   d) Calculate the vehicle's acceleration.

2. A running group is out on a weekly run in their local park. During th 1 stops to tie her shoelaces. Runner 2 approaches Runner 1 at a runnin and continues with a constant velocity. Runner 1 starts from rest, as R accelerates at 1.2 ms^{-2}.

   a) Calculate what time the runners will be side by side again.
   b) Determine the velocity at which Runner 2 would have needed to b for the two runners to be side by side again after 3 seconds.

3. A child is playing with a toy rocket in the back garden. The rocket is pump. The child fires the rocket straight into the air from its launch p at 5 ms^{-1}, with air resistance negligible.

   a) What will the rocket's velocity be when it reaches its maximum h

   The garden has a fence around it that stands 2 metres high.

   b) Show by calculation whether the rocket will reach the height of th
   c) Show that the time it takes for the rocket to reach its maximum he

4. During a Physics lesson the teacher provides you with the following a
- Light gates
- A trolley
- Data-logging software
- Runway ramp
- Video software
- Piece of card

The teacher sets the task of investigating the acceleration of the trolley of the ramp.

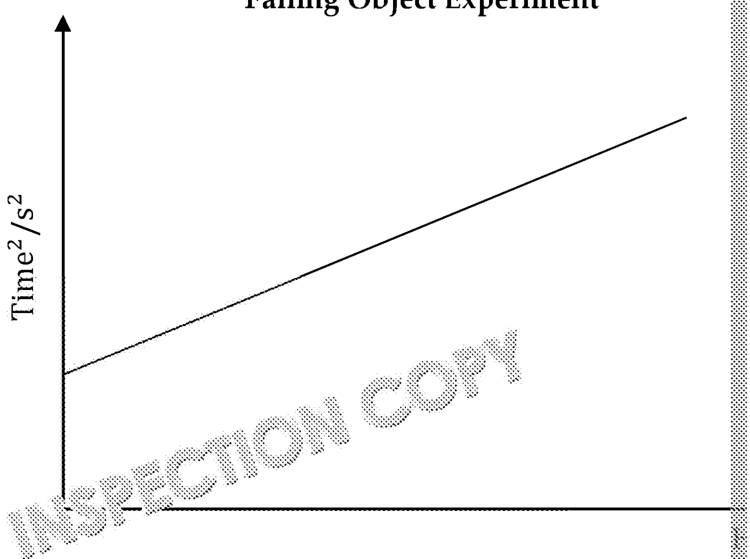
a) Describe how you would use the apparatus provided to investiga trolley.
b) State a potential source of error in the experiment.
c) Explain how this error could be eliminated or minimised to increa re

5. A group of Year 12 physicists carry out an experiment to determine th in free fall, g.

The experimental method involves dropping a steel ball from an initia height h. An electronic timer is used to measure how long it takes for through the height, h. The group repeats the experimental method on

The students plot a graph of t^2 against h, similar to the graph below. T the equation $s = ut + ½gt^2$ to calculate g.

Falling Object Experiment



a) State the general equation for a straight line graph.
b) Explain how you could use the graph to calculate the acceleratio
Hint: Compare $s = ut + ½gt^2$ and your answer from (a).
c) Suggest one limitation of the experiment.

6. A car manufacturer is carrying out research into safe road practice to i and safety features. The tests concentrate on appropriate stopping dis consequences of reaction time.

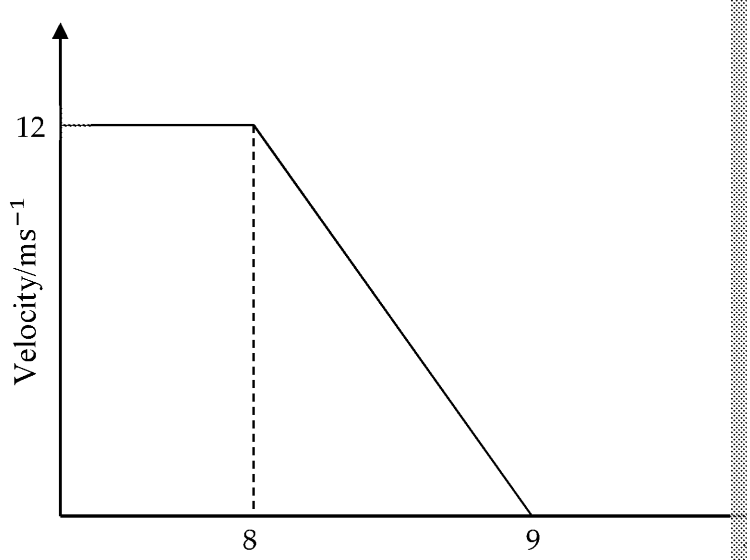
a) Define the term *stopping distance.*

To evaluate a stopping distance, the company needs to have knowled and braking distances.

b) Define each distance and give an example of a factor that would a
c) Explain why gaining knowledge of stopping distances, and the fa would be beneficial to the company.

The government has published regulations about maintaining safe dis They state that vehicles should maintain a distance of 5 metres in all 3

Consider a vehicle travelling at 27 mph (12 ms^{-1}) that has to stop sud The motion of the vehicle is described in the velocity–time graph.



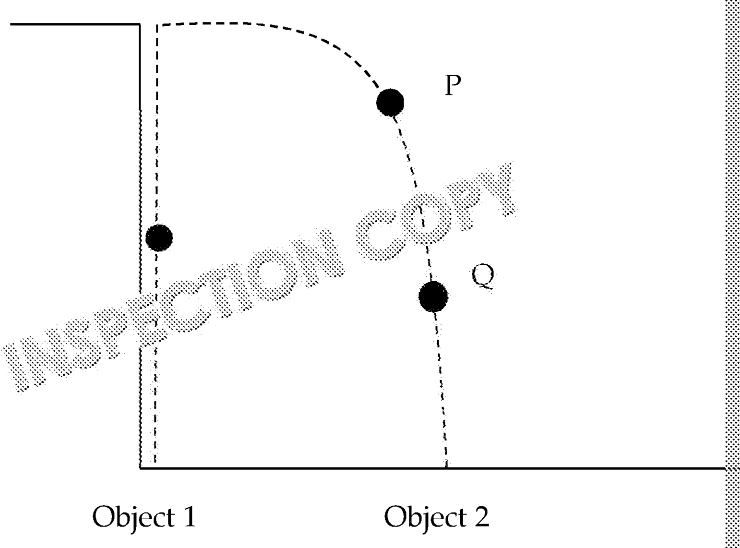
d) Calculate the braking distance of the vehicle.

The driver was illegally on her phone when she noticed the pedestria time was 3 seconds.

e) Show, by calculating the vehicle's stopping distance, why desp the regulations and maintaining the required distance, this driver r than the government states between her and the car in fron
f) Explain how scientific understanding of what affects a stopping d improve road safety.

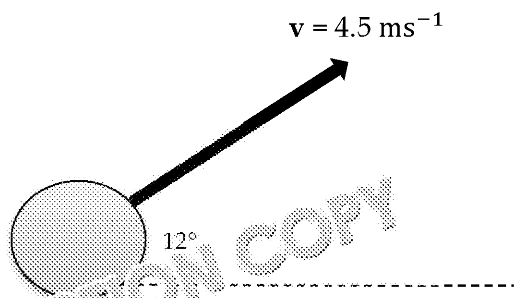
3.1.3 Projectile Motion

1. Two identical objects are dropped from an identical height. Object 1 is whereas Object 2 is thrown horizontally. The diagram indicates the m the effect of air resistance.



   a) State which object is displaying projectile motion.
   b) State and draw the direction of acceleration for both objects.
   c) For Object 2, draw its velocity vector at P and resolve the vector i vertical components.
   d) • State which component will be affected by acceleration.
      • Draw how the ball's vertical and horizontal components alte state the dependency of the vertical and horizontal motion of

2. During a football match, the ball bounces off a player's boot and is rel and a speed of 4.5 ms^{-1}. Ignore the effect of air resistance.



   a) R the velocity vector into its horizontal and vertical compo
   b) Ca ate the vertical component and the horizontal component.

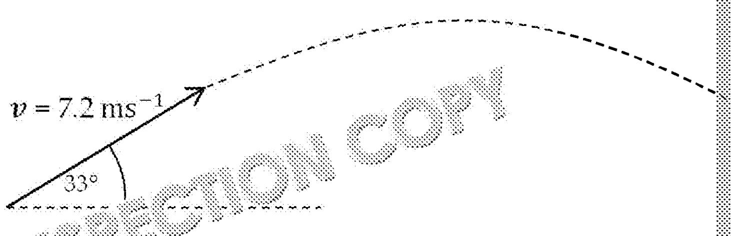
   As soon as the ball leaves the player's foot, it remains in the air for 4 s on the pitch again.

   c) Calculate how far across the pitch the ball will land.
   d) Sketch the path the ball takes during its motion and state its veloc
   e) Calculate the velocity of the ball just before it hits the pitch again.

A second player kicks the ball a few seconds later; this time the ball is
5.6 ms^{-1}. The horizontal velocity remains the same as for the first play

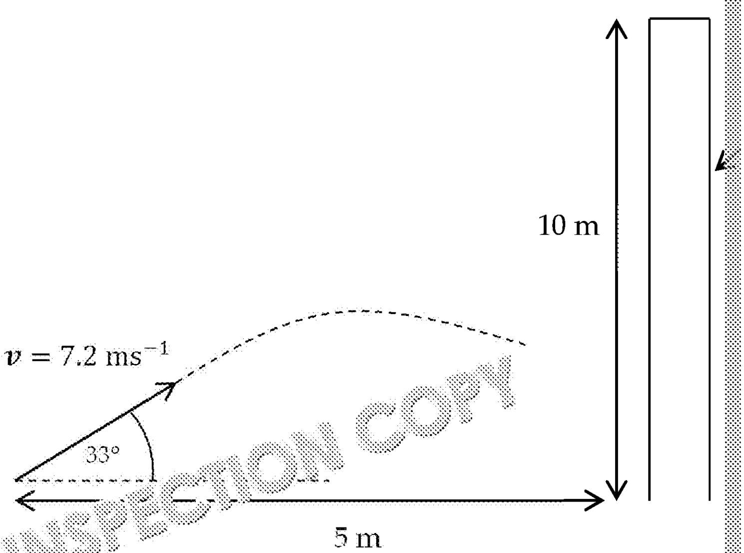
f) Calculate the angle and the vertical component of the ball's veloci
foot of the second player.

3. Chris regularly practises his cricket batting in his back garden. One of
cricket ball being fired at 7.2 ms^{-1} at 33°.



a) R[illegible] the vector and calculate its horizontal and vertical compo
b) Calculate the vector's horizontal and vertical components.
c) Explain how the vertical velocity component of the ball alters wit
it reaches its maximum height.
d) Explain how the horizontal component alters with time during th

Chris repeatedly gets into trouble with his neighbours when the crick
garden. To stop this from happening Chris builds a fence between his
neighbour's. The fence stands at 10 m tall and is placed 5 m from whe



e) Does the fence stop the ball reaching Chris's neighbour's garden?
f) Explain what effect increasing the angle would have on the result

3.2.1 Dynamics

1. Define the term *net (resultant) force.*

2. Define the newton.

3. State the equation relating the force, mass and acceleration.

4. Calculate the net force acting on a 1.67×10^3 kg car if it's accelerating at

5. A small 30 kg boat leaves the harbour with a[illegible] velocity of 2.2 ms maximum velocity of 8.1 ms^{-1} in 40 [illegible]. Calculate the net force a

6. a) Estimate the m[illegible] average man.
   b) C[illegible]te [illegible]ight of an average man on Earth.
   c) E[illegible] why the man's weight would differ if he was standing on

7. State a situation where a force would be described as:
   - Tension
   - Upthrust

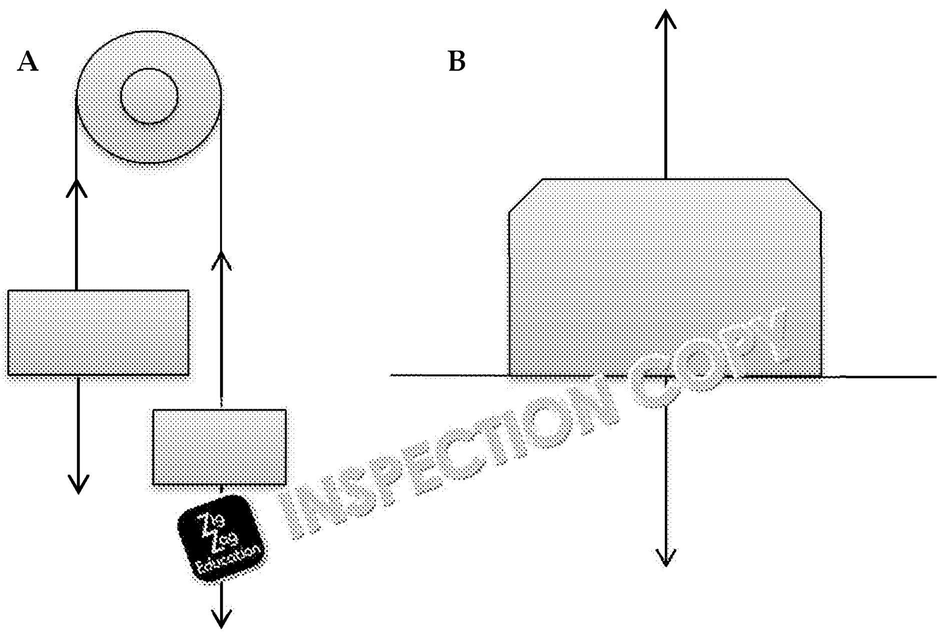
8. a) Define the term *frictional force.*
   b) State the direction in which a frictional force acts.

9. Define the normal contact force.

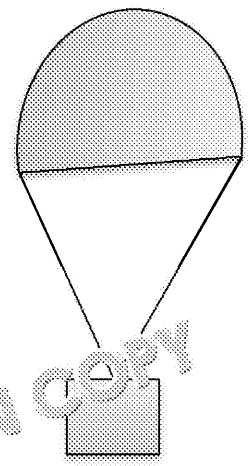
10. For each of the following free-body diagrams, label the forces acting o

A

B



11. During a humanitarian crisis a charity released food and water aid fro

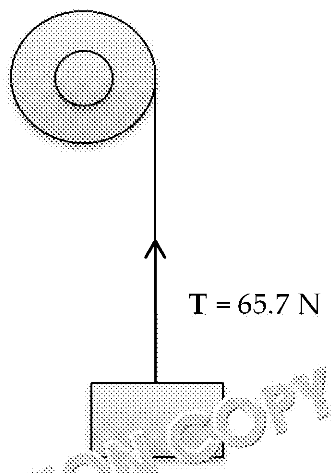


a) Sketch the forces acting on the aid supply box.

The charity found that the packages were accelerating at too fast a rat the contents of the packages were getting destroyed on impact.

b) Explain what factor needs to be changed to reduce the rate at whi towards the ground.

12. In a factory, warehouse packages are moved from the factory floor to pulley systems. A simple version of the pulley system is demonstrate package initially at rest.

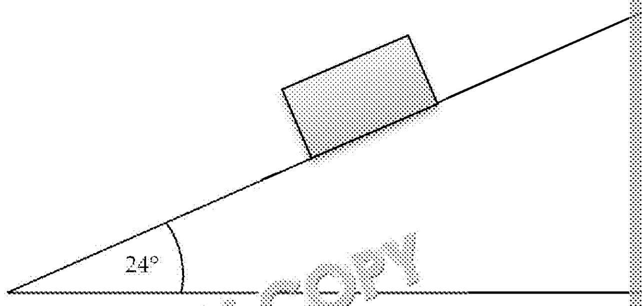


a) Calculate the [illegible] force acting on the package.
b) Describe the motion of the package.

A factory staff member alters the tension of the rope and the package

c) Calculate the tension in the rope after the staff have made the alte

13. In the same factory, the engineers also built conveyor belts to move bo
of the trucks. The box below weighs 5 kg.



a) Draw the forces acting on the box.
b) Resolve the box's downward force into its horizontal and vertical
c) Calculate the box's downward force's horizontal and vertical com
d) State the magnitude of the normal contact force.

The frictional force between the box and the conveyor belt is 23 N.

e) Calculate the rate at which the box slides down the slope.
f) Calculate the magnitude of frictional force the engineers would h
for the box to remain stationary on the conveyor belt.

3.2.2 Motion with Non-Uniform Acce

1. Define the term *drag*.

2. A coin is dropped vertically into a water fountain.

   a) Indicate on a free-body diagram the external forces acting on the
   through the water.

   b) Describe the motion of the coin as soon as it enters the fountain u
   of the fountain floor.

3. State two factors that would affect the drag applied to a body as it tra

4. While on holiday a group of friends decide to take part in a skydive. A
fall the first friend releases her parachute to reduce the speed she falls

   a) Explain how a scientific understanding of drag would benefit spo

   The skydiving company has only catered for skydivers ranging from
   friends are over 90 kg.

   b) Explain what effect this will to have on their motion during their
   c) Suggest how the company could compensate for the additional m
   d) Explain how a skydiver reaches terminal velocity.
   e) Sketch a velocity–time graph and acceleration–time graph to illus
   motion before the parachute is opened.
   f) Explain how the acceleration–time graph would alter if the effect
   present.

5. In a Physics lesson you are given the following experimental apparatu

   - Measuring cylinder
   - Beaker
   - Viscous liquid
   - Elastic bands or other method of marking distances along cylinde
   - Steel ball bearings
   - Stopwatch
   - Metre rule

   The teacher gives you the aim of determining the terminal velocity of
   travels through the viscous liquid.

   a) Describe an experiment to execute the aim.
   b) State two potential sources of error.
   c) Explain how you could minimise the two errors.
   d) Explain why the measurement of terminal velocity needs to carri
   half of the cylinder.

3.2.3 (Part 1) Equilibrium

1. Define the term *moment of force* with an equation.

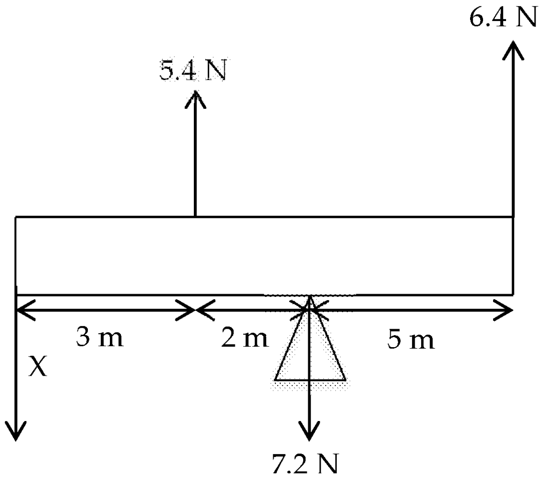
2. Define the term *couple* in terms of forces.

3. Define the term *torque of a couple* with an equation.

4. Define the *principle of moments* with an equation.

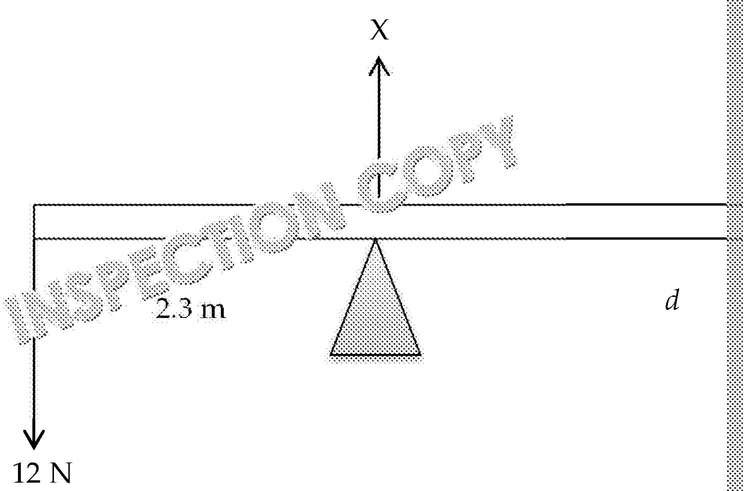
5. Define the terms *centre of mass* and *centre of gravity*.

6. The diagram below represe[illegible]a of principle of moments.



   Calculate the total moment around X and state its direction.

7. For a circus performance a balancing apparatus is set up for its perfor engineers come up with has to be in equilibrium to ensure it remains



   a) Define what is mean by the term *equilibrium of forces*.
   b) Calculate the distance *d* from the pivot.
   c) Calculate the force X.

One of the circus performers climbs onto the left end of the balancing

d) Suggest one change that could be made to ensure the system rem

8. A tugboat is held in equilibrium at the docks by three ropes attached attached with a tension A on a bearing of 90°, the second rope is attac with a tension of 15 N and the third rope is attached with tension B at

a) Draw the free-body diagram to illustrate how the tugboat is tied
b) Calculate the tensions A and B.

3.2.4 (Part 2) Density and Pressu

Continued from previous page…

9. State the equation that illustrates the relationship between density, ma

10. What is the unit for density?

11. John plays the trombone in the school orchestra. A section of his tromb be cleaned. The section is cylindrical and has a mass of 0.3 kg, a heigh of 2.3 cm. Calculate the density of the cylindrical section.

12. Pupils at a secondary school are receiving a set of injections from their s nurse administers the injection she applies a force of 10 N. The plunger medicine has the cross-sectional area of a circle with radius 0.2 cm.

   a) Calculate the pressure exerted by the nurse on the syringe plunge
   b) Explain what would happen to the pressure if the nurse exerted le plunger.

13. A boat with a small hole sinks to just below the surface of the sea so th submerged. The boat floats under the surface.

   a) Sketch the forces acting on the boat.

   The fisherman owning the boat wants to determine the pressure on th

   b) Explain what parameters the fisherman has to measure in order t acting on the bottom of the boat.
   c) State a potential source of error that would affect the accuracy of fisherman.
   d) Use Archimedes' principle to explain how the fisherman could ha on the bottom of the boat if he knew the weight of the water displ

   Archimedes' principle, like many other scientific theories and theorem discovery, which was continually developed over time to become the

   e) State the role of the scientific community in validating scientific k

3.3.1 (Part 1) Work and Conservation o

1. Define the term *work done* by a force and define its unit.

2. Explain what is meant by the *principle of conservation of energy.*

3. State whether work done is a scalar or vector.

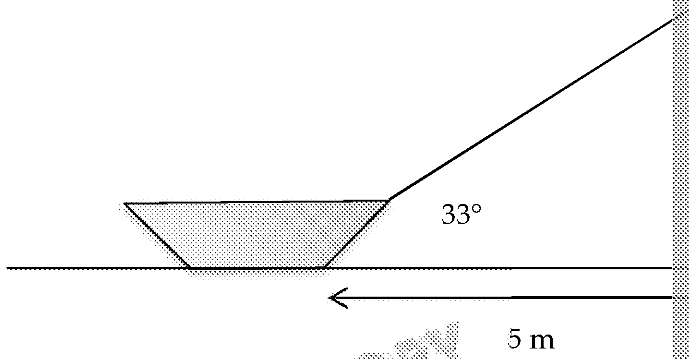
4. Indicate whether work is done in the following examples:
   a) A child pushing a toy car along the floor.
   b) A child holding a toy car.
   c) A handyman standing at the top of a ladder.
   d) A handyman climbing up a ladder.

5. Explain the energy transfers occurring in the following situations:
   a) A girl starting to cycle her bike.
   b) A car wheel travelling across a tarmac road.
   c) A musician singing into a microphone.

6. A family are going sledging on New Year's Day. To speed up the wal
   daughter onto his shoulders. He lifts with a force of 30 N through a h

   a) Calculate the work done in lifting the child.

   Later on, the dad is pulling his daughter along on a sledge. He is pull
   along a distance of 5 m.



   b) Calculate the work done in pulling the child along on the sledge.

3.3.2 (Part 2) Kinetic and Potential E

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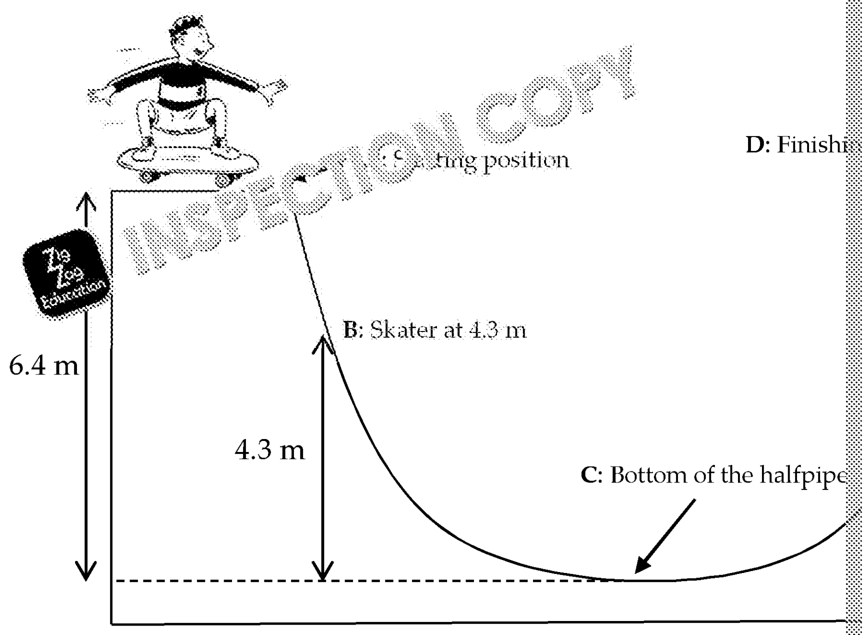
7. A skateboarder competing in a halfpipe competition completes his fir and his board together weigh 85 kg.

   The following diagram indicates the skateboarder's journey down the



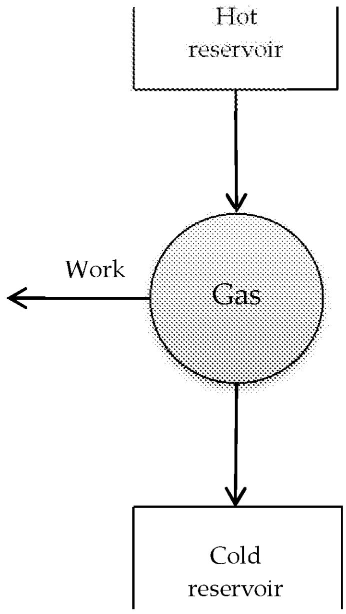
   a) Derive the equation for kinetic energy.
   b) Derive the equation for potential energy.
   c) Calculate the gravitational potential energy of the skateboarder a
   d) Use the principle of conservation of energy to calculate the maxim skateboarder can achieve at point C.
   e) Calculate the maximum velocity the skateboarder could achieve a
   f) Explain why during the competition the skater would not reach th calculated at C.

3.3.3 (Part 3) Power

8. In Italy, Vespas are a common mode of transport. The engine generate
force of around 150 N and can reach a maximum speed of 26 ms^{-1} on

   a) Derive the equation for power, $P = Fv$.
   b) Calculate the power generated by the Vespa's engine.
   c) When a Vespa travels up hills, explain what would happen to the
   could generate.

9. A heat engine works by providing heat to natural gas. It transfers the
high temperature to a lower temperature. The engine then releases the
reservoir. By completing this cycle, work is generated by the engine.



The input energy supplied by the hot reservoir is 400 J and output wo

   a) Explain why the output energy is not equal to the input energy.
   b) Define the term *power* and define its unit.
   c) Calculate the power generated by the engine in 20 seconds.
   d) Calculate the percentage efficiency of the engine.
   e) Explain why it is ethically important for companies using these h
   high efficiencies.

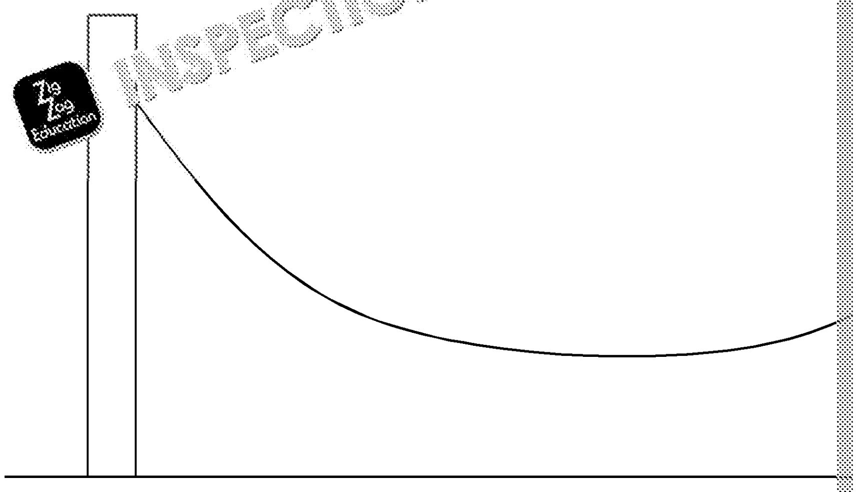
3.4.1 (Part 1) Springs

1. Explain the differences between tensile and compressive deformation

2. In the following situations, indicate whether tensile deformation or co
   is occurring:

   a) A dog owner pulling on the lead of their dog
   b) A child jumping on a bed

3. The following force diagram illustrates a slack l ed between trees
   in this situation and indicate whether the a sile or compressive.



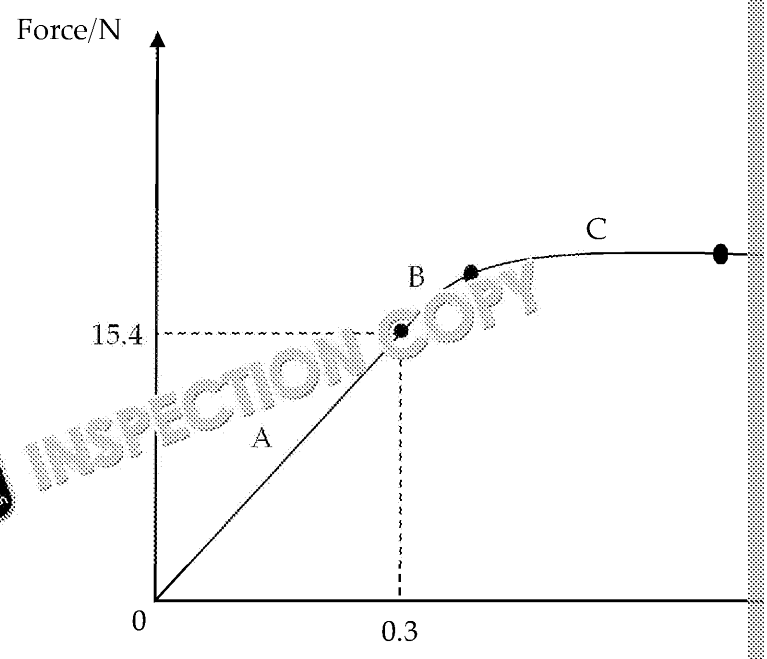
4. State Hooke's law.

5. Explain why a force constant is included in the equation of Hooke's la

6. Wire A is said to have a larger force constant (k) than B.

   a) State what that means about wire A compared to wire B.
   b) If you wanted to ensure that both wires experienced the same app
      stretched, what would you have to do differently with wire A com
   c) Calculate the force used to stretch wire A if it was stretched a dist
      rest position and has a force constant of

7. An experiment was carried out on different spring characteristics. The springs tested are plotted on a graph:

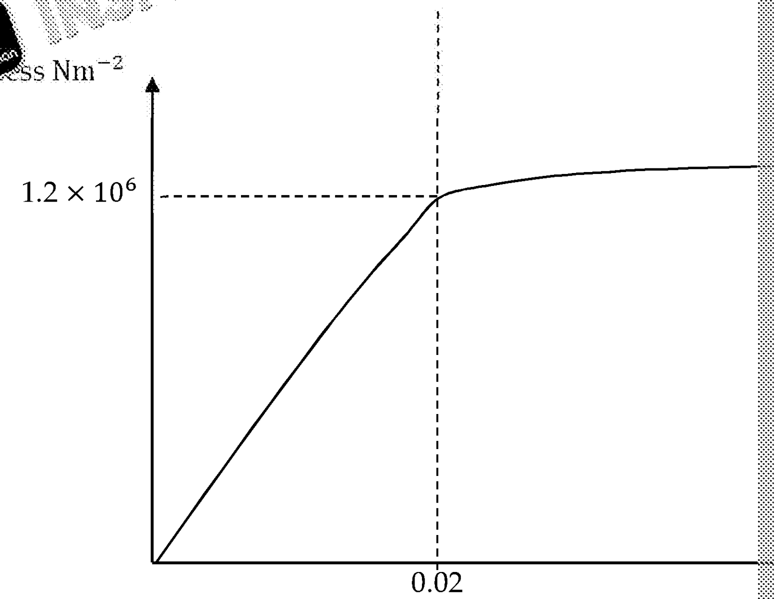


a) Explain which section of the graph you can apply Hooke's law to
b) Explain how the force constant k can be determined from the gra in part a).
c) Calculate the work done on the spring during stage A.
d) Given that E=½kx², sketch the graph of E plotted against x^2 for st
e) Calculate the elastic potential energy of the string during stage A

Continued from previous page…

8. A Year 12 Physics class carry out an experiment to investigate the You different materials. They are provided with the following apparatus:
   - Vernier scales
   - Two wires of the same material
   - Slotted masses
   - Clamp stand
   - Metre rule

   The students plotted the following graph of their results of the experi



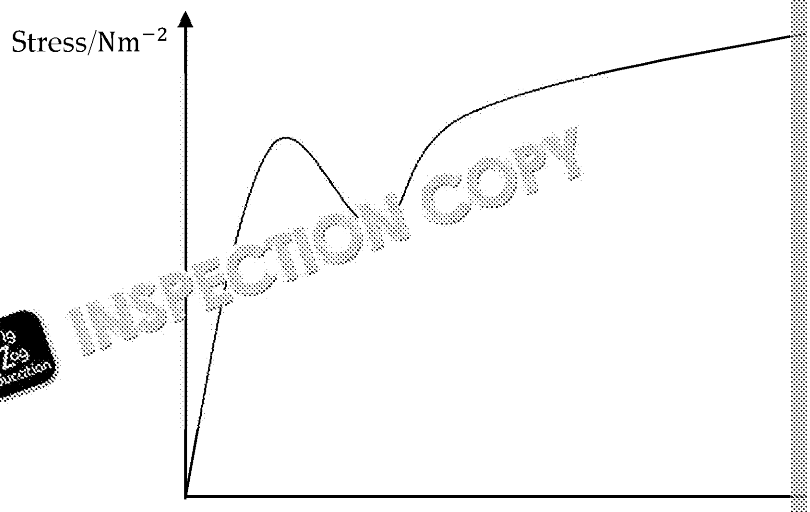
   a) Define the terms:
      - Stress
      - Strain
   b) Describe how the students would have used the apparatus to ach determine Young's modulus.
   c) State what type of material is represented in the graph.
   d) Calculate Young's modulus for the linear section of the graph.
   e) Explain how Young's modulus would alter if you changed the len

   Another Year 12 Physics class repeated the experiment with a differen following table is an example of the results they achieved:

	Stress/Nm^{-2}
Mass 1	0
Mass 2	2.1
Mass 3	4.3
Mass 4	6.5

f) Plot the graph of stress against strain for the students' results and material they must have used during the experiment.

The Year 12 class repeated the experiment again for another material. obtained the graph below:



g) State what material is represented by the graph results.

h) Indicate and explain what regions illustrate:

- Elastic deformation
- Plastic deformation

3.5.1 (Part 1) Newton's Laws of Mo

1. State Newton's first and second laws of motion.

2. Explain in terms of Newton's third law of motion how a rocket is able launch pad.

3. A lift in a hotel regularly carries hotel guests from the lobby to their ro

   a) Explain, in terms of Newton's laws, how the normal contact force hotel guests relate if the lift is moving at a constant velocity up the

   A hotel guest gets out the lift on [illegible] floor.

   b) Explain, in terms of Newton's laws, how the forces acting on the l [illegible] the lift, and therefore how the lift's motion alte

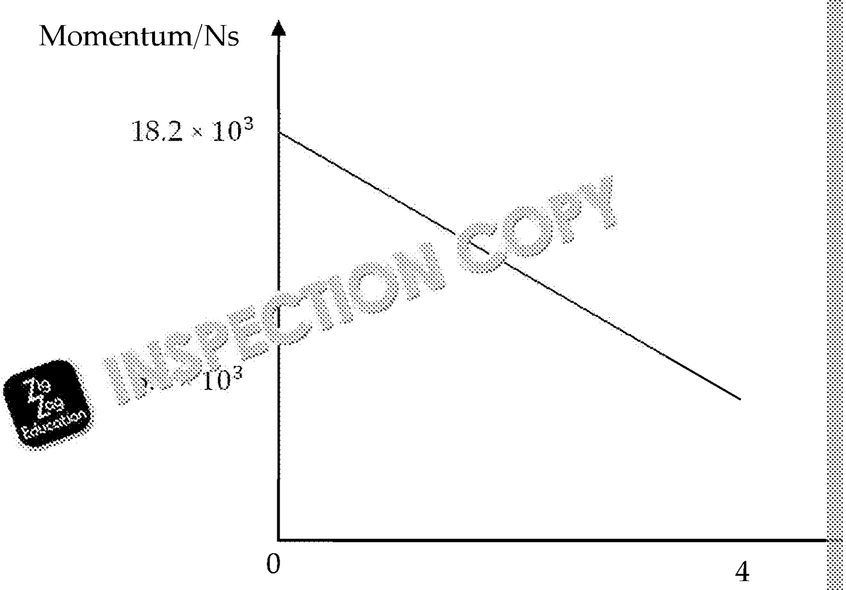
4. A group of friends are playing a game of beach volleyball while on ho player from Team 1 hits the ball over the net. The ball is 0.8 kg and tra velocity of 5.6 ms^{-1} over the net.

   a) Define the term *linear momentum*.
   b) Explain whether linear momentum is a scalar or a vector.
   c) Calculate the linear momentum of the volleyball.

5. A family are driving their car weighing 1.5×10^3 kg and travelling at brake suddenly as a cyclist pulls out in front of the car. The car reduce over 4 seconds.

   a) Explain what is meant by the equation $F = \frac{\Delta p}{\Delta t}$.

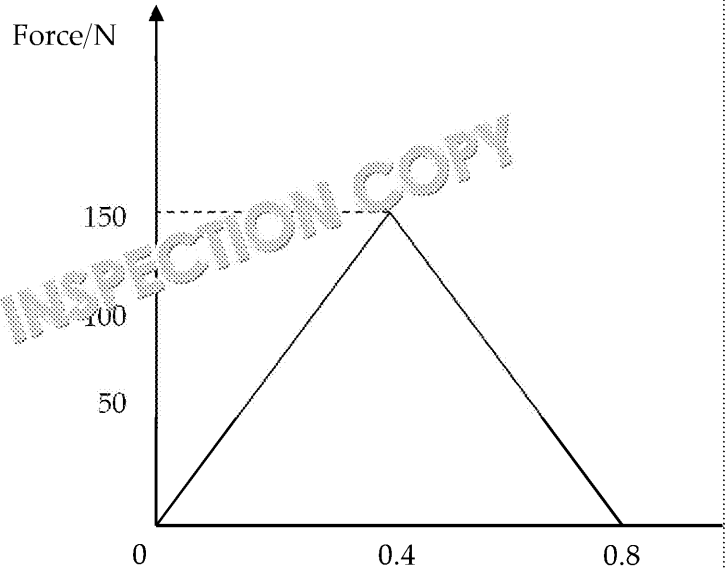
   The following graph indicates the car's change in momentum over the



   b) Calculate the net force of the car.
   c) Explain why knowledge of net force and momentum change wou situations involving car and passenger safety.

6. Derive $F = ma$ from $F = \frac{\Delta p}{\Delta t}$ to show how $F = ma$ is a special case of the second law of motion, $F = \frac{\Delta p}{\Delta t}$.

7. During a golf tournament, various golf outlet companies recorded an golf balls during impact to attempt to find ways to improve the desig of a golf ball upon impact with a golf club was plotted for the first gol



a) Define the term *impulse*.
b) Explain how you could use the graph to determine the impulse o impact.
c) Calculate the impulse of the golf ball from the graph.
d) Explain the effect on impulse if the ball was in contact with the go the force applied remained the same.

The same measurements were taken for a second golfer. The average applied to the 0.04 kg golf ball was 120 N and the impact time was rec

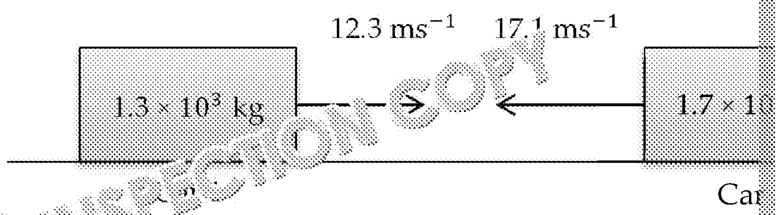
e) Calculate the velocity of the golf ball as it is released from contact **Hint**: the golf ball will initially be at rest ($u = 0$) as it sits on the tee

3.5.2 (Part 2) Collisions

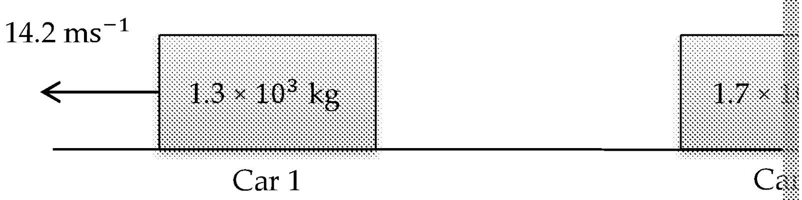
Continued from previous page…

8. Two cars collide at a large crossroads. The following diagram describ and after impact.

Before



After



a) Define the principle of conservation of momentum.
b) Calculate the velocity, indicating magnitude and direction, of Car
c) Determine whether the collision was perfectly elastic or inelastic. your answer.
d) Explain what could be altered in order to reduce the speed of Car why this would be beneficial.
e) Indicate how society could use knowledge of collisions to minimi during a collision.

Preview of Questions Ends Here

Answers

2.1.1 Physical Quantities

1. ms^{-2} (1)
2. Incorrect:
   C. Energy (1); should be joules (1)
   D. Force (1); should be newtons (1)
3. a) 14 300 ms (1)
   b) i) The time it takes her to complete the 100 metre stretch will increase
   ii) 0.0025 kms^{-1}
   iii) $t = \frac{d}{v} = \frac{100}{2.5} = 40$ s (1)
4. a) i) 70–80 kg (1)
   ii) $E = mgh$
   E = (70 to 80) × 9.8[illegible]
   E = 3845.5[illegible] (1)
   [illegible] answer for energy that falls in between these two values
   b) i) [illegible] gravitational potential energy of the second friend at the end o[illegible] be greater. (1)
   ii) $E = mgh$
   E = (80 to 90) × 9.81 × 5.6
   E = 4394.88–4944.24 J (1)
   E = 4.39 kJ–4.49 kJ (1)
   Accept any answer that falls in between these two values.

2.1.2 SI Units

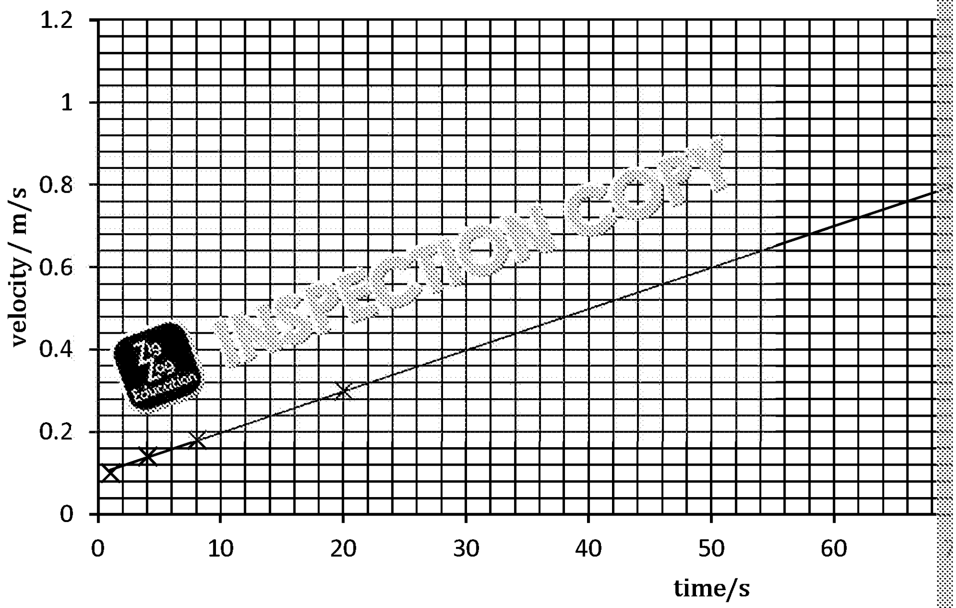
5. a) ½ for each correct answer.

Base Quantity	
Mass	
Length	
Temperature	
Current	
Amount of substance	
Time	

6. a) 0.05 A (½)
   b) 0.0001 s (½)
   c) 0.0252 kg (½)
   d) 700 m (½)
7. a) i) $\text{velocity} = \frac{\text{metre}}{\text{second}} = \text{m.s}^{-1}$ (1)
   ii) $\text{density} = \frac{\text{kilogram}}{\text{metres cubed}} = \text{kg.m}^{-3}$ (1)
   b) i) $\text{m}^3 = \frac{4}{3}\pi\ \text{m}^3$
   m^3 = const[illegible]
   [illegible] both sides of the equation are m^3; therefore, the eq
   ii) [illegible] $= \text{ms}^{-2} \times \text{ms}^{-1}$ (1)
   [illegible] $= \text{m}^2\text{s}^{-3}$
   The units on both sides of the equation are not the same and theref homogeneous. (1)
   iii) $\text{m} = \text{m.s}^{-1} \times \text{s} + 0.5 \times \text{m.s}^{-2} \times \text{s}^2$ (1)
   $\text{m} = \text{m} + 0.5 \times \text{m}$ (1)
   All the units on both sides of the equation are in metres and therefore
8. a) pm; nm; μm; mm (1)
   b) kV; MV; GV; TV (1)
   c) cm; dm (1)

9. a) • No, there are no units in the table column headings. (1)
• No, the title of each quantity in the table has not been specified. (1)
b) • Correct axis title labels (1)
• Correct axis unit scales and labels (1)
• Correct plotting of data points and construction of line of best fit (1

Linear motion of a falling object



2.2.1 Measurements and Uncertainties (i)

1. *Systematic error*: refers to a measurement error that causes repeated measure from the true value by the same factor. (1) The source of the error is due to a method, the surroundings of the experiment or the apparatus used to carry o
2. *Random error*: refers to a measurement error that causes repeated measureme one another and results in a spread of measured values around a true value. The error is randomised and as a result of sources that cannot be foreseen. (1
3. B (1)
4. Examples:
Systematic error: apparatus or instruments used incorrectly (1), instruments c measurements of parameters of the experiment recorded incorrectly. (1)
Random error: electronic noise in an electric circuit (1), natural external factor equipment's inability to detect small changes (lack of sensitivity) (1), human measurements (1), incorrect technique of measurement (1)
Give full marks for any suitable answer for each error.
5. The contribution of random error can be reduced by:
• Repeating the experiment (1)
• Taking the mean of measured values (1)
• Identifying the anomalies (1)
Give full marks (1) for any suitable answer
6. Precision is the term used to describe the proximity of an experiment's repeate
7. Accuracy is the term used to describe how close in proximity a single measured v
8. D (1)

9. a) • High accuracy due to each shot hitting the target centre (true value
• High precision due to all the shots being in extremely close proxim
OR
High precision due to the shots recorded having a small spread. (1)
b) If each shot became less accurate then each shot would be recorded furt
(true value). (1)
c) • High precision due to shots recorded in close proximity to each oth
OR
High precision due to the shots recorded having a small spread. (1)
• Low accuracy due to each of the shots being recorded a significant
(true value). (1)
d) If the shots recorded became less precise it wou[illegible] ult in increase in th
(increase the distances between each of t[illegible] (1)

2.2.1 Measurements and Uncerta[illegible]

1. percentage uncerta[illegible] $= \frac{\text{[illegible]}}{\text{average value}} \times 100\%$ (1)
2. a) 0.[illegible])
b) pe[illegible]ge uncertainty$= \frac{0.1}{26.4} \times 100 = 0.4\%$ (1)
c) $Length = (A \pm \Delta A) + (B \pm \Delta B)$
$Length = (10.2 \pm 0.1) + (16.2 \pm 0.1)$ (1)
$Length = (10.2 + 16.1) \pm (0.1 + 0.1)$
$Length = 26.3 \pm 0.2$ cm (1)
d) $Length = (A \pm \Delta A) - (B \pm \Delta B)$
$Length = (34.2 \pm 0.1) - (8.2 \pm 0.1)$ (1)
$Length = (34.2 - 8.1) \pm (0.1 + 0.1)$
$Length = 26.1 \pm 0.2$ cm (1)
e) If $y = \frac{A}{B}$
% uncertainty in y = % uncertainty in A + % uncertainty in B (1)
f) Same (1)
g) A = 2 × % uncertainty in r (1)
% uncertainty in r $= \frac{0.1}{3} \times 100\%$
% uncertainty in r = 3.33% (1)
% uncertainty in A = 2 × 3.33
% uncertainty in A = 6.7% (1)
3. a) i) Correct construction of line of best fit (1)
ii) Gradient of best line fit $= \frac{1.95-0.15}{8-0} = 0.23$ (1)
b) i) uncertainty = |gradient of line of best fit − gradient of line of worst fi
uncertainty = |0.23 − 0.29| = 0.06 (1)
ii) percentage uncertainty $= \frac{\text{uncerta[illegible]}}{\text{gradi[illegible]}} \times 100$ (1)
percentage un[illegible]nt[illegible] $= \frac{[illegible]}{0.23} \times 100$
[illegible]e[illegible] uncertainty = 26.1% (1)
iii) [illegible]centage difference $= \frac{\text{decrease}}{\text{original value}} \times 100\%$ (1)
percentage difference $= \frac{(0.85-0.6)}{0.85}$
percentage difference = 0.294 = 29.4 % (1)

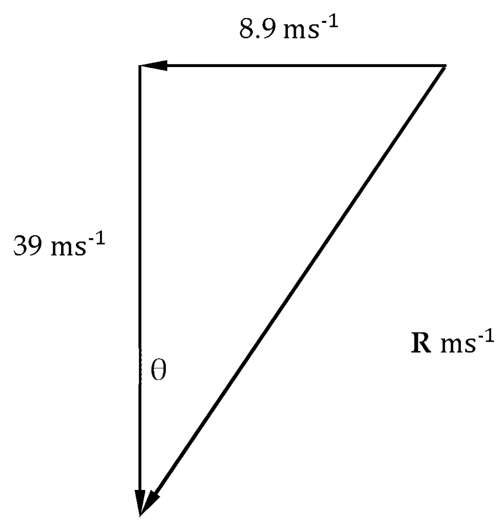
c) i) The term 'zero error' refers to the error that occurs as a result of an instr[illegible] displaying a reading when it should be zero. (1)

ii) The ammeter should display a zero measurement (no charge) when the[illegible] the plates; therefore, the source of the error will be a false reading for ze[illegible]

iii) All the values measured for charge will be higher than their true values[illegible] value obtained for energy will be higher than its true value. (1)

2.3.1 Scalars and Vectors

1. *Scalar quantity*: is a term that refers to a quantity that is defined by a magnitu[illegible]
2. *Vector quantity*: is a term that refers to a quantity that is defined by both a magnit[illegible]
3. a) Vector (1)
   b) Vector (1)
   c) Scalar (1)
   d) Scalar (1)
   e) Vector (1)
   f) Scalar (1)
   g) Sc[illegible])
   h) Sc[illegible]
4. A direct[illegible] (1); since tension (force) is a vector quantity and therefore is defi[illegible] direction. (1)
5. a) 6.3 ms^{-1} + 3 ms^{-1} = 9.3 ms^{-1} (1), due east. (1)
   b) 6.3 ms^{-1} – 3 ms^{-1} = 3.3 ms^{-1} (1), due east. (1)
6. a)



- Correct order of vector addition (1)
- Correct choice of angle (1)
- Correct direction of resultant vector (1)

b) Magnitude: $\mathbf{R} = \sqrt{(39^2) + (8.9^2)} = 40$ ms[illegible]

Direction: $\tan\theta = \frac{8.9}{39}$; $\theta = \tan^{-1}$[illegible] 12.86° (1)

c) $a_h = a\cos\theta$ (1)

OR

a[illegible]θ [illegible]

d) a_h [illegible] × cos70 (1)

$a_h = 3.36\ ms^{-2}$ (1)

OR

$a_v = 9.81 \times \sin 20$ (1)

$a_v = 3.36\ ms^{-2}$ (1)

Preview of Answers Ends Here