Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number | Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Tuesday 20 May 2014 – Morning
Time: 1 hour 30 minutes

Paper Reference
6PH01/01

You must have:
Ruler, protractor

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- The list of data, formulae and relationships is printed at the end of this booklet.
- Candidates may use a scientific calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

1/1/1/1/

P 4 3 1 1 8 A 0 1 2 8

PEARSON

SECTION A

Answer ALL questions.

For questions 1–10, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Select the answer in which both quantities are vectors.

☒ **A** acceleration, speed

☒ **B** displacement, velocity

☒ **C** mass, time

☒ **D** power, weight

(Total for Question 1 = 1 mark)

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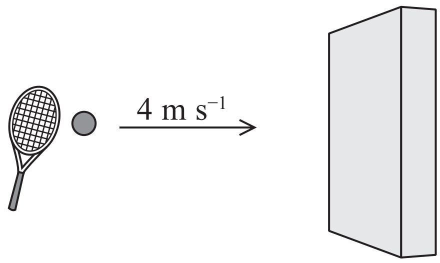
2 A tennis ball hits a wall perpendicularly at a speed of 4 m s^{-1} and rebounds at the same speed.



Taking the initial velocity as positive, the change in velocity is

☒ **A** –4 m s^{-1}

☒ **B** –8 m s^{-1}

☒ **C** 0 m s^{-1}

☒ **D** 8 m s^{-1}

(Total for Question 2 = 1 mark)

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3 A mass of 0.05 kg is lifted at a slow steady speed by a 5 W electric motor.

The height the mass rises in 8 s is found using

☒ **A** $\dfrac{5}{0.05 \times 9.81 \times 8}$

☒ **B** $\dfrac{5 \times 8}{0.05 \times 9.81}$

☒ **C** $\dfrac{0.05 \times 9.81}{5 \times 8}$

☒ **D** $\dfrac{0.05 \times 9.81 \times 8}{5}$

(Total for Question 3 = 1 mark)

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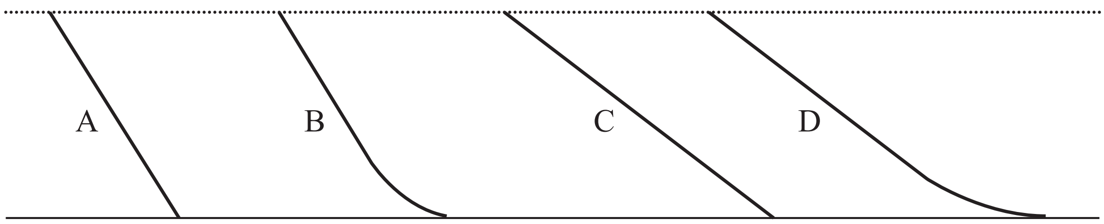
4 A child slides down four frictionless slides A, B, C and D.



The speed of the child at the bottom of slides A, B, C and D is given by v_A, v_B, v_C and v_D respectively.

Choose the correct statement.

☒ **A** $v_A = v_B = v_C = v_D$

☒ **B** $v_A > v_B$ and $v_C > v_D$

☒ **C** $v_A > v_B > v_C = v_D$

☒ **D** $v_A > v_C$ and $v_B > v_D$

(Total for Question 4 = 1 mark)

5 A spring with a spring constant 140 N m^{-1} is extended. The elastic potential energy stored is 1.6 J.

The extension of the wire is found using

☒ **A** $\frac{1.6}{140}$

☒ **B** $\frac{2 \times 1.6}{140}$

☒ **C** $\sqrt{\frac{1.6}{140}}$

☒ **D** $\sqrt{\frac{2 \times 1.6}{140}}$

(Total for Question 5 = 1 mark)

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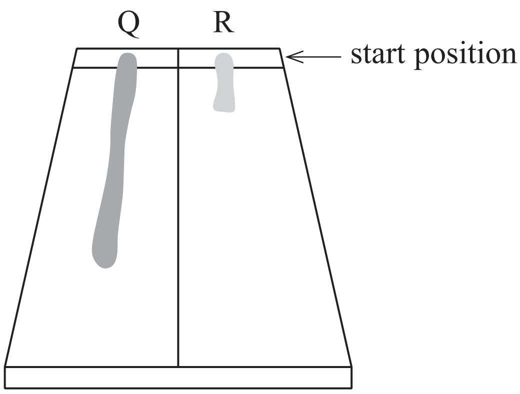
6 Q and R are drops of two different fluids which have been placed on one end of a tile. The tile is then tilted.

The diagram shows how the drops spread down the tile.



Which could be a correct explanation for the different lengths shown?

☒ **A** R has a greater viscosity than Q.

☒ **B** R has a greater density than Q.

☒ **C** R has a greater temperature than Q.

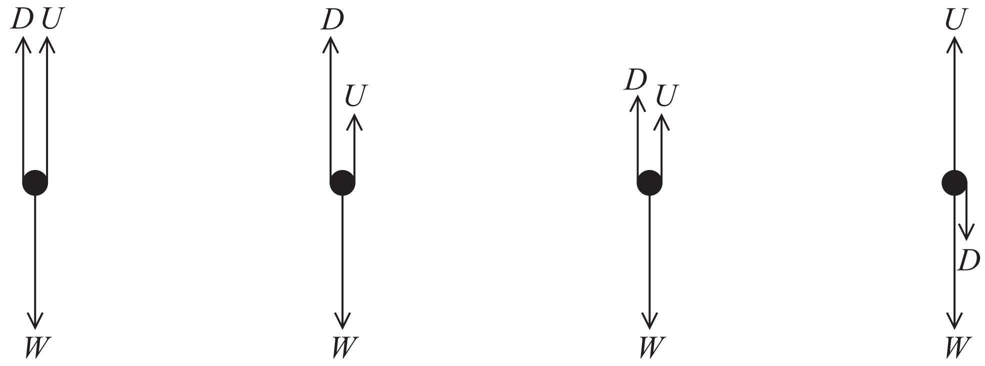
☒ **D** All of the above.

(Total for Question 6 = 1 mark)

7 A small object is falling at terminal velocity in a large container of oil.

Which diagram correctly represents, in magnitude and direction, the forces acting on the object as it reaches terminal velocity?

W = weight
U = upthrust
D = drag



☒ **A** ☒ **B** ☒ **C** ☒ **D**

(Total for Question 7 = 1 mark)

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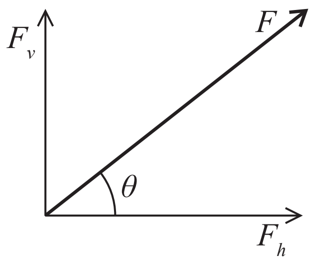
8 A force F is resolved into two components, F_h and F_v, at right angles to one another.



Which statement is **not** true?

☒ **A** Decreasing θ increases the magnitude of F_h.

☒ **B** Increasing θ increases the magnitude of F_v.

☒ **C** F_h and F_v have magnitudes that when added together give a total equal to the magnitude of F.

☒ **D** F_h and F_v have magnitudes that when added together give a total greater than the magnitude of F.

(Total for Question 8 = 1 mark)

9 A car of mass m travelling with a velocity v comes to rest over a distance d in time t.

The constant frictional force acting on the car while it is braking is found using

☒ **A** $\frac{mv}{2t}$

☒ **B** $\frac{2mv}{t}$

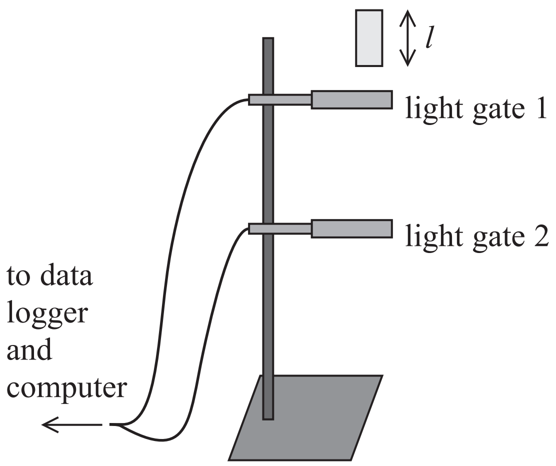
☒ **C** $\frac{mv^2}{2d}$

☒ **D** $\frac{2mv^2}{d}$

(Total for Question 9 = 1 mark)

10 An experiment is carried out to find a value for g, the acceleration of free fall.

A weighted card of known length l is dropped through two light gates. The light gates are attached to a data logger and a computer. By inputting the length of the card into the computer two values of velocity and the time interval between them can be obtained. Using these values of velocity, a value of g can be determined.



Assuming that air resistance is negligible, which of the following would produce a more reliable value of g?

☒ **A** Drop the card from a greater height.

☒ **B** Ensure that the card is dropped from rest.

☒ **C** Make the card shorter.

☒ **D** Move the light gates further apart.

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

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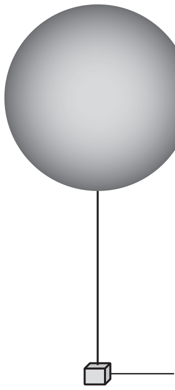
SECTION B

Answer ALL questions in the spaces provided.

***11** A student is asked to calculate the magnitude of a weight required to keep a spherical helium filled balloon stationary in the air.



The only measurement taken is the diameter d of the balloon. The student is given the values of the density of air ρ_a, the density of helium ρ_h and gravitational field strength g.

(a) Using the symbols given, write an expression for

(i) the volume V of the balloon

(1)

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(ii) the mass of the helium inside the balloon

(1)

....

(iii) the mass of the air displaced by the balloon

(1)

....

(iv) the upthrust on the balloon.

(1)

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(b) Assuming the weight of the balloon and string are negligible, write an expression for the magnitude of the required weight.

(1)

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(Total for Question 11 = 5 marks)

12 (a) On a cold night ice forms over the surface of a small garden pond. The next day, the air temperature rises and the ice begins to melt slowly.

Melting can be speeded up by breaking the ice with a hammer.

(i) State the property of ice which means that it can be broken with a hammer.

(1)

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(ii) Suggest why the broken ice melts more quickly.

(1)

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....

(b) Ice is a hard material.

(i) Define the term hard.

(1)

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(ii) The hardness of ice increases as its temperature decreases.

Explain why skaters often call colder ice 'fast ice' and warmer ice 'slow ice', due to this variation in hardness.

(2)

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(Total for Question 12 = 5 marks)

13 A copper wire and a steel wire of identical lengths l are soldered together. The compound wire is stretched by a force F and the total length increases by 0.010 m.

cross-sectional area of copper = 0.80×10^{-6} m^2

cross-sectional area of steel = 1.3×10^{-6} m^2

Young modulus of copper = 1.3×10^{11} Pa

Young modulus of steel = 1.8×10^{11} Pa

(a) (i) Show that the extension of the copper wire is about twice the extension of the steel wire.

(3)

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(ii) Hence calculate the extension of the copper wire.

(2)

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Extension = ...

(b) When the applied force is increased, it is found that the ratio of the extension of the copper wire to the extension of the steel wire becomes much greater.

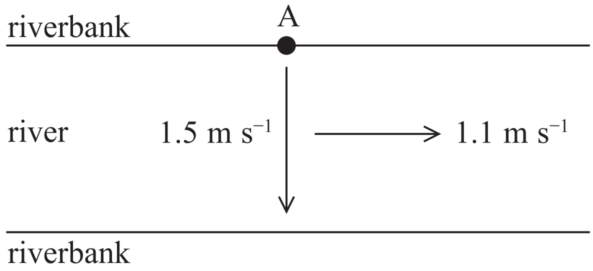
State the property of the copper that accounts for this high value of the ratio.

(1)

....

(Total for Question 13 = 6 marks)

14 A student rows across a river heading from point A. Her boat is headed in a direction at right angles to the bank and she rows through the water at a constant speed of 1.5 m s^{-1}. The river flows with a current of 1.1 m s^{-1}.



(a) Calculate the velocity of her boat relative to the riverbank.

(4)

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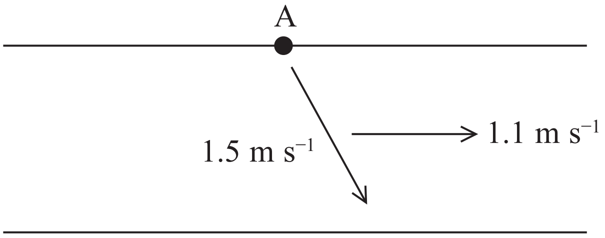
Magnitude of velocity = ...

Angle of velocity to the riverbank = ...

(b) Another student also rows through the water at a constant speed of 1.5 m s^{-1} and heads their boat in a direction at 65° to the riverbank.



On the grid below draw a scaled vector diagram to determine the velocity of the boat.

(3)

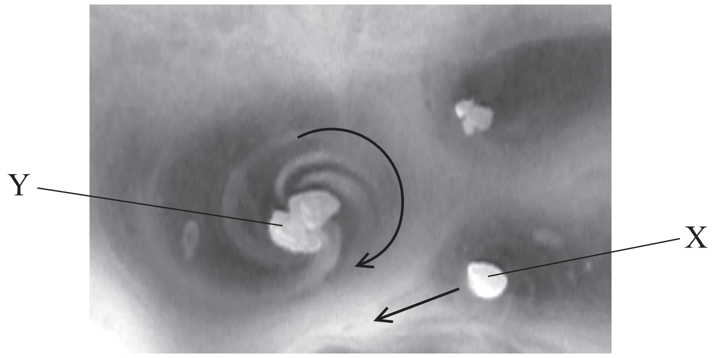
Magnitude of velocity = ...

Angle of velocity to the riverbank = ...

(Total for Question 14 = 7 marks)

15 Solid carbon dioxide changes state directly from solid to gas. This process is called sublimation. Solid carbon dioxide, when placed on water, will move rapidly across the surface due to jets of ejected gas.

The diagram below shows the direction of movement for two large pieces of solid carbon dioxide placed on water.



*(a) When placed at rest on water, piece X begins to move rapidly in the direction shown.

With reference to Newton's laws of motion explain the motion of piece X.

(5)

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(b) When placed at rest on water, piece Y remained in one position whilst spinning around.

Suggest why piece Y remains in one position.

(2)

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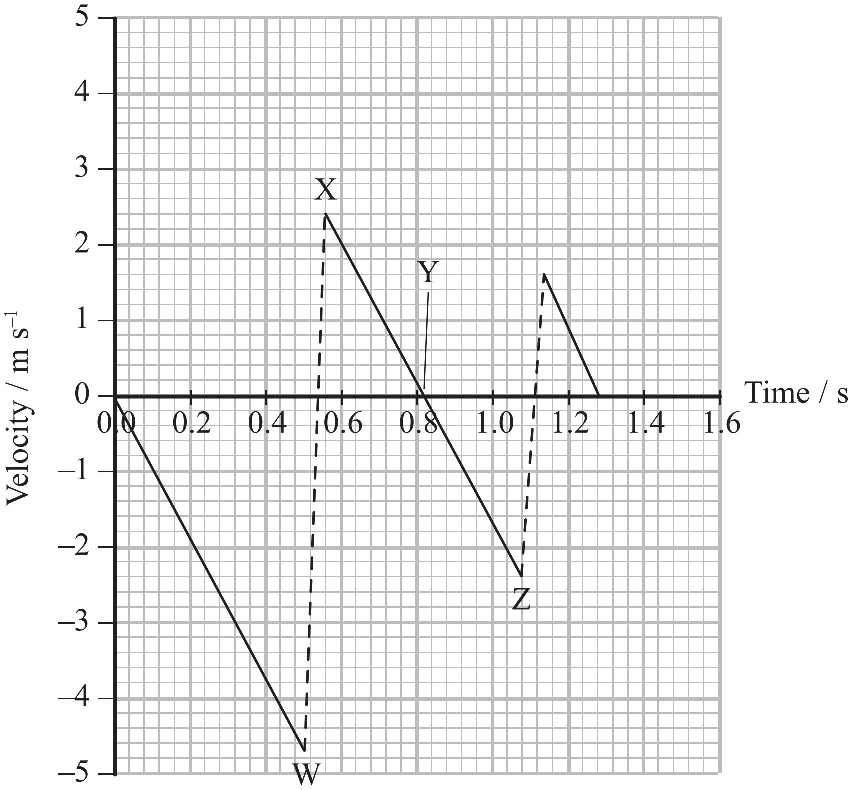
(Total for Question 15 = 7 marks)

16 A basketball is dropped vertically onto the horizontal ground and bounces twice before being caught. The graph shows how the velocity of the basketball varies with time.



(a) Suggest why the downward sloping lines are all parallel.

(1)

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(b) (i) State the reason for the upwardly sloping dotted lines.

(1)

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(ii) Describe how the gradient of the dotted lines would change if the basketball was not fully inflated.

(1)

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P 4 3 1 1 8 A 0 1 6 2 8

(c) Calculate the initial height through which the basketball fell.

(2)

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Height = ...

(d) (i) Show that the kinetic energy of the basketball at X is about 1 J.

mass of ball = 0.4 kg

(2)

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(ii) Hence calculate the height of the basketball at Y.

(2)

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....

Height = ...

(e) The velocity of the basketball on impact at W is greater than the velocity on impact at Z.

State a reason for the difference in velocities at W and Z.

(1)

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(Total for Question 16 = 10 marks)

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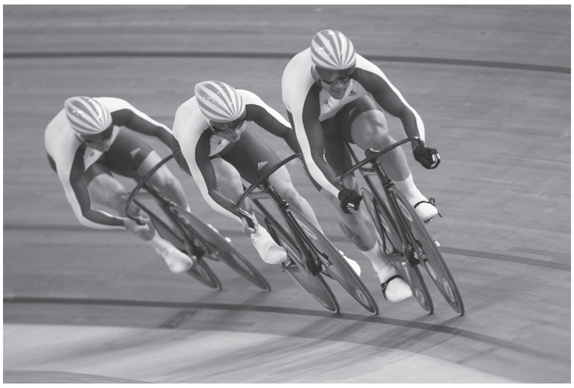
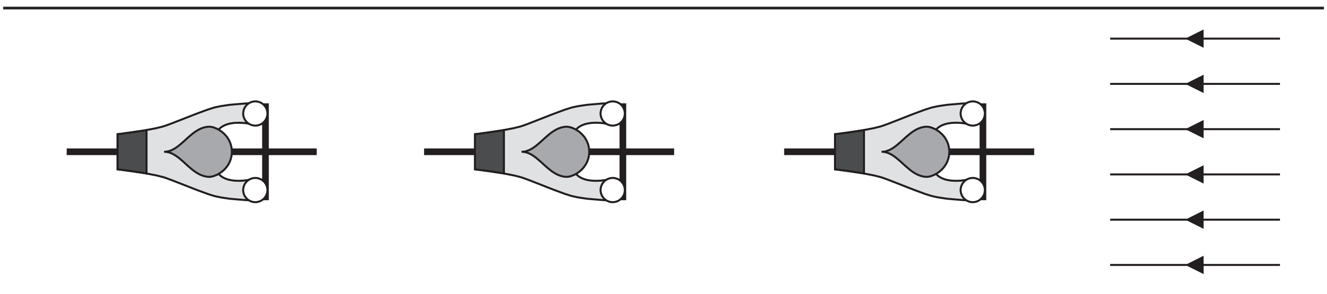
17 Air resistance is the greatest source of friction opposing the motion of cyclists.

In addition to lightweight, streamlined equipment and clothing, the position of a cyclist amongst the other cyclists can reduce the amount of air resistance acting on him.



(a) (i) The air flow behind the lead cyclist becomes turbulent.



lead cyclist

Draw in the air flow around the lead cyclist, labelling the regions of laminar and turbulent flow.

(2)

(ii) The lead cyclist uses about a third more energy than those behind him.

Explain this statement using the idea of the relative velocity between the cyclist and the air around him.

(2)

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Turn over ▶

(b) As the speed of a cyclist increases, the air resistance acting on him becomes proportional to the square of his speed.

i.e. air resistance = constant × speed^2

The cyclist has a power output P when travelling at a certain constant speed. He then doubles his speed.

Calculate his new power output as a multiple of P.

(3)

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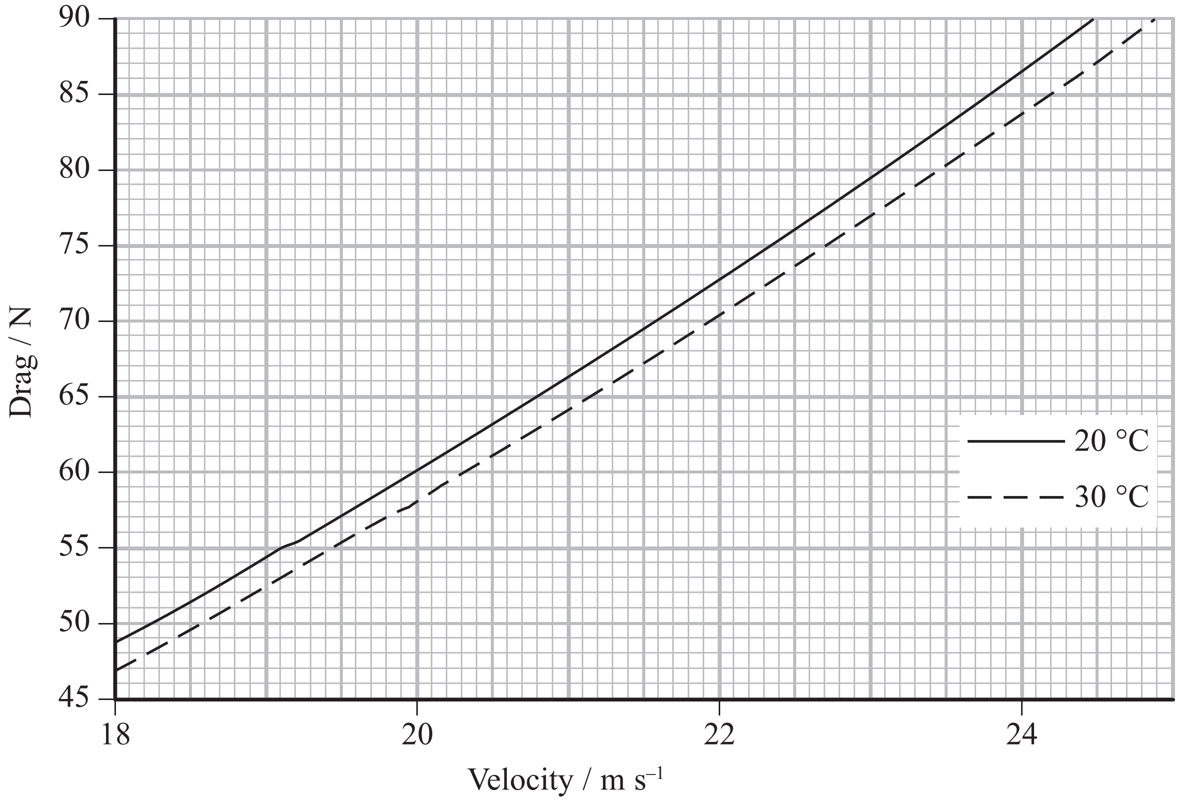
Power = ...

(c) When designing the velodrome for the 2012 Olympics in London, the temperature of the building was considered as a factor that could affect the speed of the cyclists.

The graph shows how the drag on a typical cyclist varies over a range of velocities.



P 4 3 1 1 8 A 0 2 0 2 8

(i) Explain which is the most suitable temperature to use in the velodrome.

(1)

Temperature = ...

....

....

(ii) The table shows the drag forces acting on a cyclist travelling at a speed of 21 m s^{-1}.

Drag force at 20 °C	Drag force at 30 °C
66.4 N	64.2 N

The cyclist travels 4 km at 21 m s^{-1}.

Calculate the difference between the work the cyclist must do when cycling the 4 km at 20 °C and at 30 °C.

(2)

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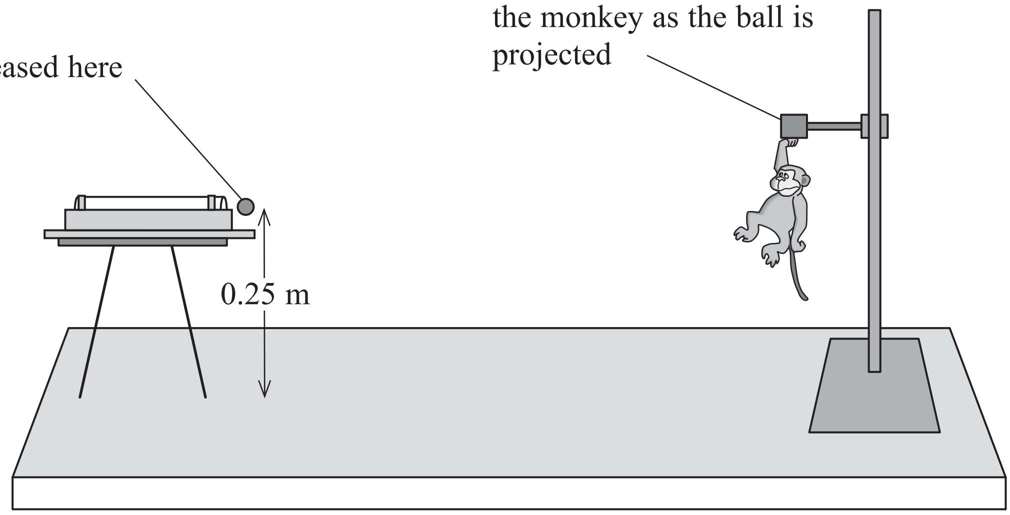
Difference = ...

(Total for Question 17 = 10 marks)

18 The monkey and hunter is a thought experiment to illustrate the independence of the horizontal and vertical motion of a projectile.

A student models the experiment by projecting a table tennis ball horizontally at a toy monkey. The ball and monkey are initially at the same height, 0.25 m, above the bench.

The monkey drops at the instant the ball is projected. The monkey and the ball will always meet irrespective of their horizontal separation.



(a) (i) Show that the time taken for the ball to fall to the bench is about 0.2 s.

(2)

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(ii) The ball is projected with a horizontal velocity of 2.6 m s^{-1}.

Calculate the horizontal distance that the ball should travel if the ball is to hit the monkey as it reaches the bench.

(2)

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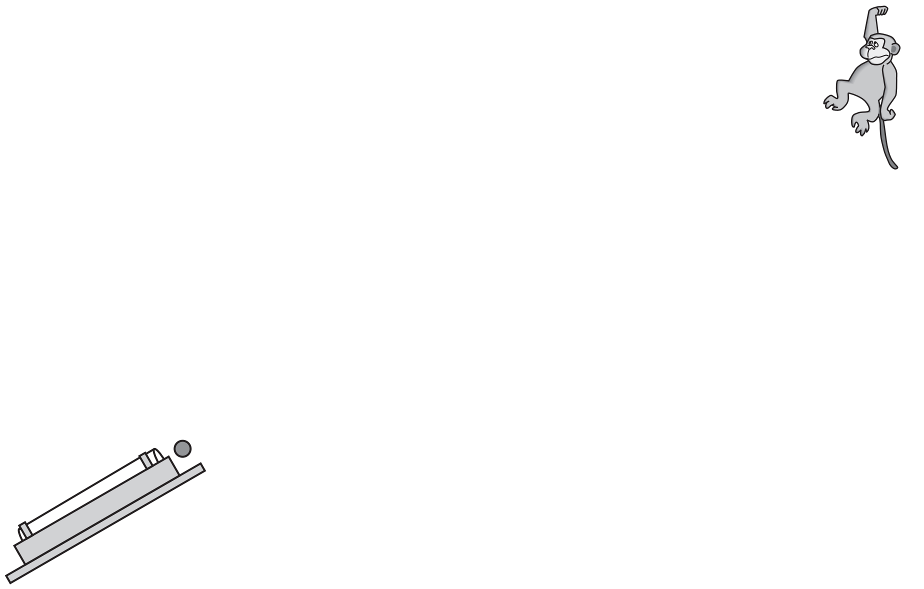
Horizontal distance = ...

(b) A variation of this experiment is where the monkey is initially higher so that the ball has to be projected upwards towards the monkey. The two objects will still always meet.



(i) Complete the diagram above to show the paths of the ball and the monkey.

(2)

(ii) The ball is projected with a velocity of 3.0 m s^{-1} at an angle of 20° to the horizontal. If the monkey is at a horizontal distance of 0.50 m, how far will it have fallen when it meets the ball?

(3)

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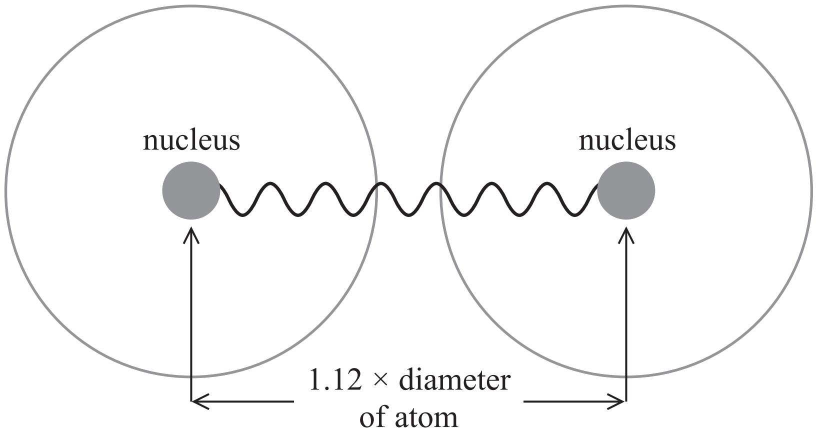
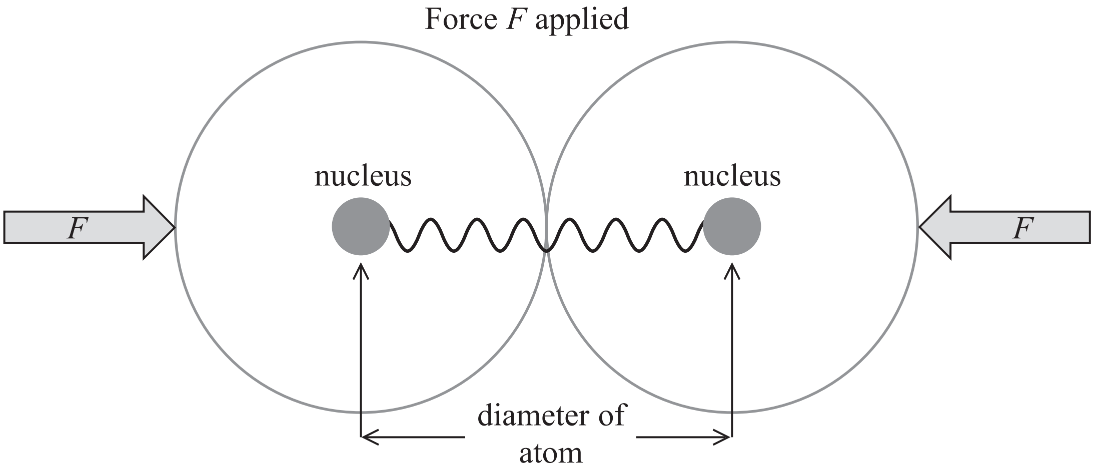
Distance fallen = ...

(Total for Question 18 = 9 marks)

19 The forces between the two atoms in a molecule of hydrogen can be modelled using a spring. When in equilibrium the nuclei are separated by 1.12 × diameter of the atom.



(a) When the atoms are squashed together by a force F, the spring is under compression.



When the force F acts on the atoms, the separation between the nuclei becomes equal to the diameter of the atom.

Calculate the force F.

spring constant for hydrogen = 1130 N m^{-1}

diameter of an atom of hydrogen = 1.06×10^{-10} m

(3)

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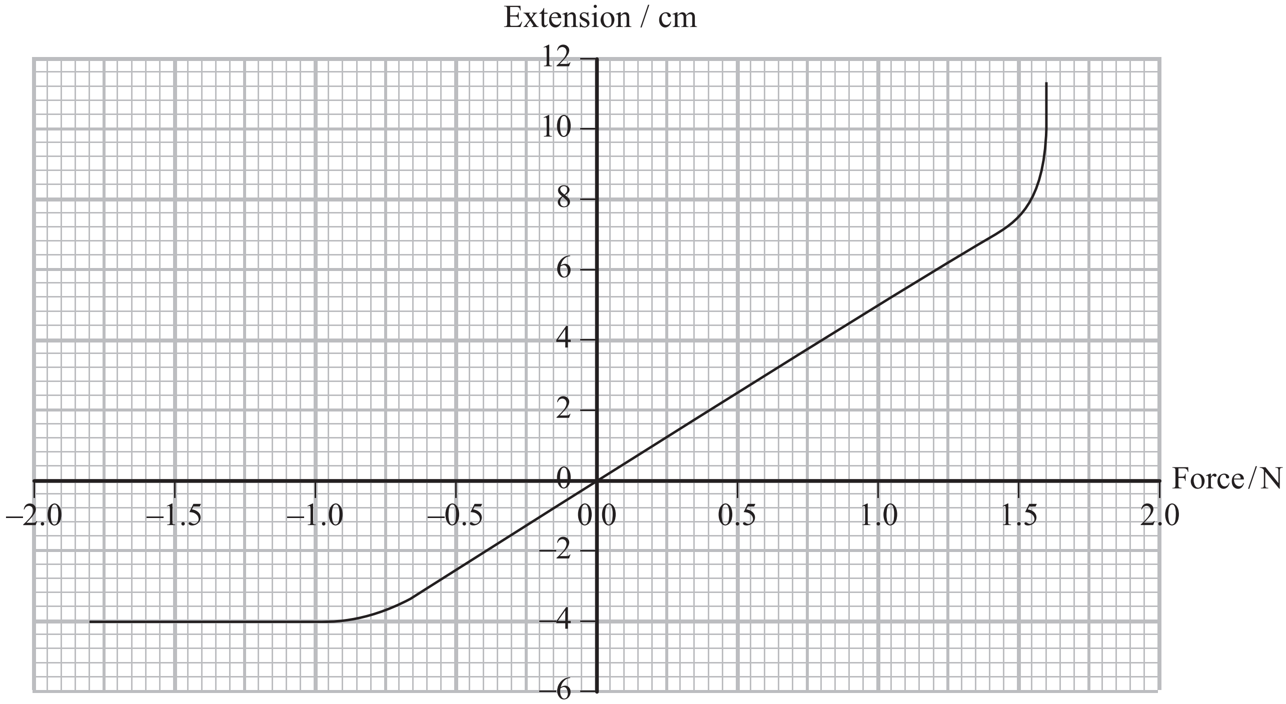
....

Force = ...

(b) A student carries out an experiment to model the forces between atoms.

A varying force is applied to the end of a spring. The student measures the length of the spring and calculates the extension for each force applied.

The student plots the following graph.



(i) Explain the shape of the graph.

(3)

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(ii) Use the graph to calculate the spring constant.

(2)

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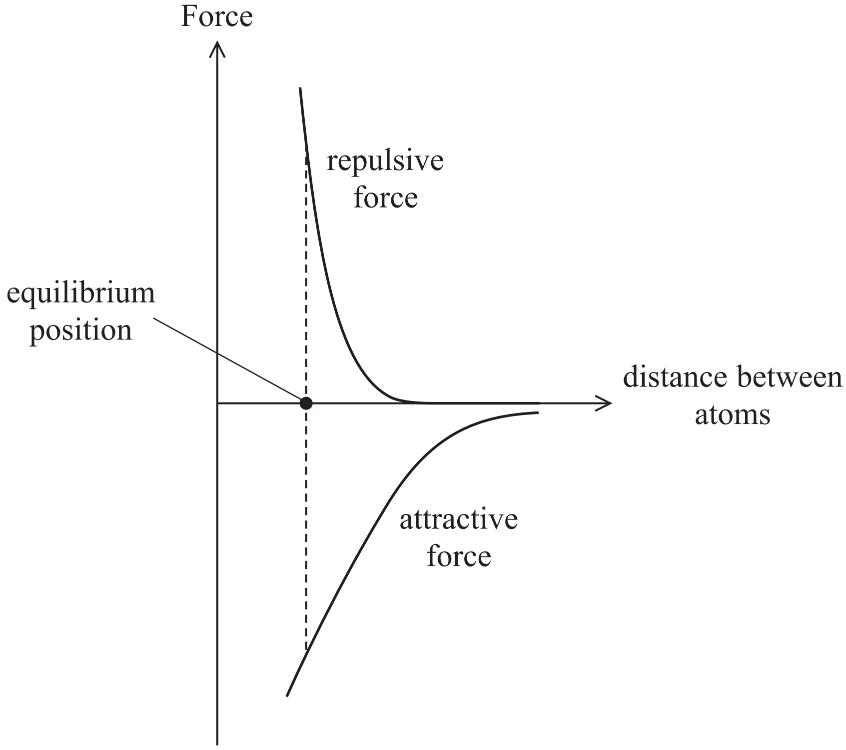
Spring constant = ...

*(c) The graph below shows how the forces acting between two atoms consist of a repulsive force and an attractive force. At the equilibrium position, the sum of these forces is zero.



Use the graph to explain why the forces between atoms are attractive when they are pulled apart and repulsive when pushed together.

(3)

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(Total for Question 19 = 11 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \text{m s}^{-2}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19}\ \text{C}$	
Electron mass	$m_e = 9.11 \times 10^{-31}\ \text{kg}$	
Electronvolt	$1\ \text{eV} = 1.60 \times 10^{-19}\ \text{J}$	
Gravitational field strength	$g = 9.81\ \text{N kg}^{-1}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34}\ \text{J s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$	

Unit 1

Mechanics

Kinematic equations of motion

$$v = u + at$$
$$s = ut + \tfrac{1}{2}at^2$$
$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$
$$g = F/m$$
$$W = mg$$

Work and energy

$$\Delta W = F\Delta s$$
$$E_k = \tfrac{1}{2}mv^2$$
$$\Delta E_{grav} = mg\Delta h$$

Materials

Stokes' law: $F = 6\pi\eta rv$

Hooke's law: $F = k\Delta x$

Density: $\rho = m/V$

Pressure: $p = F/A$

Young modulus: $E = \sigma/\varepsilon$ where
Stress $\sigma = F/A$
Strain $\varepsilon = \Delta x/x$

Elastic strain energy: $E_{el} = \tfrac{1}{2}F\Delta x$

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