Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

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
WPH01/01

You must have:
Ruler

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 ▶

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1/1/1/1/2/

P 4 2 9 2 6 X 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 A rocket of mass *m* lifts off with an acceleration *a* due to the engines providing a thrust *T*.

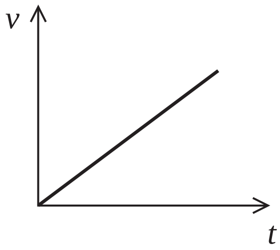
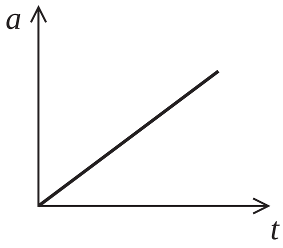
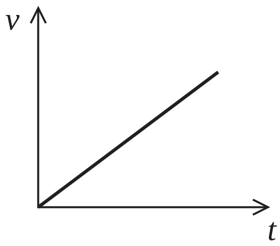
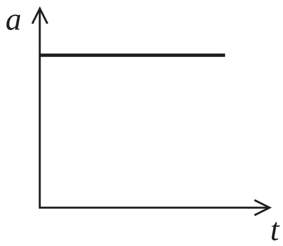
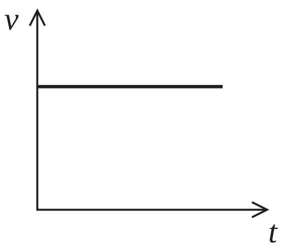
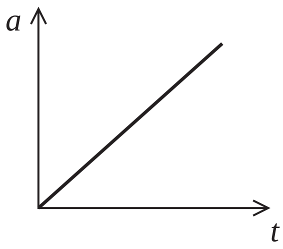
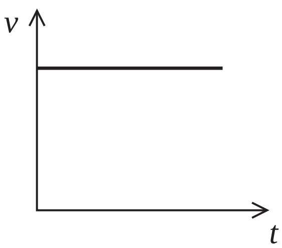
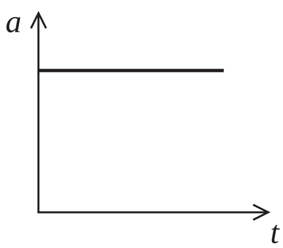
Which row in the table correctly identifies the quantities *m*, *T* and *a* as scalar or vector?

	m	T	a
☒ **A**	vector	scalar	vector
☒ **B**	vector	scalar	scalar
☒ **C**	scalar	vector	vector
☒ **D**	scalar	vector	scalar

(Total for Question 1 = 1 mark)

2 The table shows velocity-time and acceleration-time graphs for an object in motion.

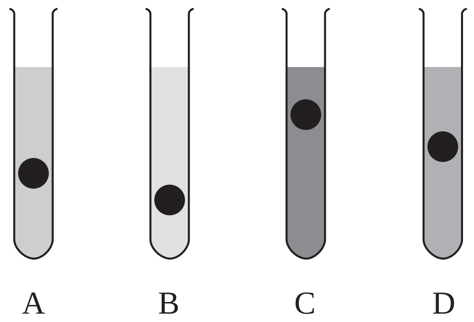
Which row of the table contains a pair of graphs that could be consistent for the motion of the object?

	Velocity-time graph	**Acceleration-time graph**
☒ **A**		
☒ **B**		
☒ **C**		
☒ **D**		

(Total for Question 2 = 1 mark)

Use the following diagram to answer Questions 3 and 4

Four identical steel balls are dropped simultaneously into test tubes filled with different motor oils. The diagram shows the positions of the balls after a short time.



3 Which test tube, A, B, C or D, contains the oil with the lowest viscosity?

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 3 = 1 mark)

---

4 Test tube D is heated and the ball is dropped into it in the same way.

Compared with the previous experiment, the position of the ball in test tube D, after the same short time, is

☒ **A** higher up because the viscosity of the oil is greater.

☒ **B** higher up because the viscosity of the oil is lower.

☒ **C** lower down because the viscosity of the oil is greater.

☒ **D** lower down because the viscosity of the oil is lower.

(Total for Question 4 = 1 mark)

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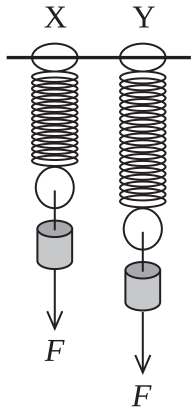
5 Two springs, X and Y, are stretched by the same force F. The spring constant of X is double the spring constant of Y.



If the energy stored in Y is E, the energy stored in X is given by

- ☒ **A** $E/4$
- ☒ **B** $E/2$
- ☒ **C** E
- ☒ **D** $2E$

(Total for Question 5 = 1 mark)

6 The coefficient of restitution of a ball is the ratio of its speed after it bounces to the speed before it bounces.

The kinetic energy of a ball before it bounces is 3.3 J and the kinetic energy after it bounces is 0.9 J.

The coefficient of restitution is calculated using

- ☒ **A** $\dfrac{3.3}{0.9}$
- ☒ **B** $\sqrt{\dfrac{3.3}{0.9}}$
- ☒ **C** $\sqrt{\dfrac{0.9}{3.3}}$
- ☒ **D** $\dfrac{0.9}{3.3}$

(Total for Question 6 = 1 mark)

7 An increasing force is applied to a spring and the corresponding extension is measured.

The spring constant k of the spring is

☒ **A** the applied force per unit extension.

☒ **B** the applied force per unit length.

☒ **C** the gradient of the extension (y-axis) against force (x-axis) graph.

☒ **D** the area under the extension (y-axis) against force (x-axis) graph.

(Total for Question 7 = 1 mark)

Use the following photograph to answer Questions 8 and 9

The photograph shows a tennis ball being thrown vertically upwards.

8 Which row of the table shows the correct directions of the velocity and acceleration of the tennis ball while it is moving vertically upwards?

	Velocity	**Acceleration**
☒ **A**	↓	↓
☒ **B**	↓	↑
☒ **C**	↑	↓
☒ **D**	↑	↑

(Total for Question 8 = 1 mark)

9 The tennis ball reaches a maximum height of 2.8 m.

The initial velocity would be given by

☒ **A** $2 \times 9.81\ \text{N kg}^{-1} \times 2.8\ \text{m}$

☒ **B** $9.81\ \text{N kg}^{-1} \times 2.8\ \text{m}$

☒ **C** $\sqrt{2 \times 9.81\ \text{N kg}^{-1} \times 2.8\ \text{m}}$

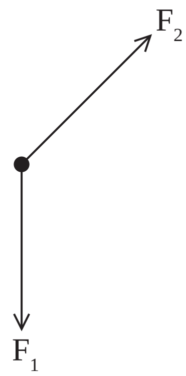
☒ **D** $\sqrt{9.81\ \text{N kg}^{-1} \times 2.8\ \text{m}}$

(Total for Question 9 = 1 mark)

P 4 2 9 2 6 X A 0 7 2 8

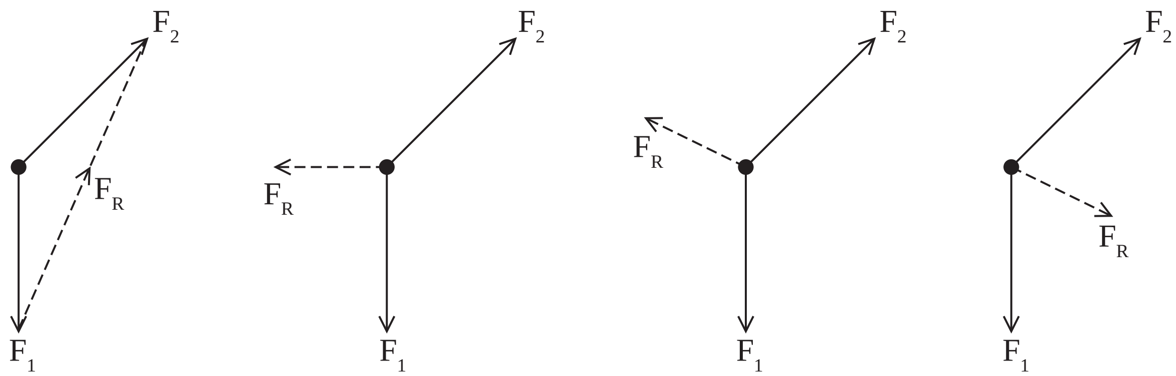
Turn over ▶

10 Two forces F_1 and F_2 act on an object as in the diagram below.



If F_1 and F_2 are drawn to scale, the resultant force can be found by measuring the length of the resultant line F_R.

Which of the following diagrams shows the correct position of the line F_R?



☐ **A**

☐ **B**

☐ **C**

☐ **D**

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

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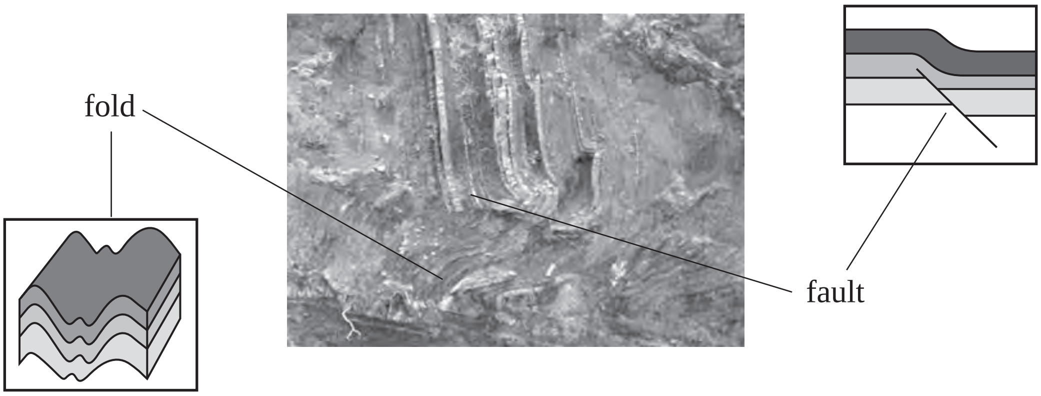
Section B begins on page 10

SECTION B

Answer ALL questions in the spaces provided.

11 Sandstone is able to fault (break), fold (bend) and carry seismic (earthquake) waves.



Faults can occur if the temperature of the sandstone is low enough for it to become brittle. This causes it to break under pressure.

(a) State and explain the properties of the sandstone that allow it to fold.

(2)

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(b) State and explain the properties of the sandstone that allow it to carry seismic waves.

(2)

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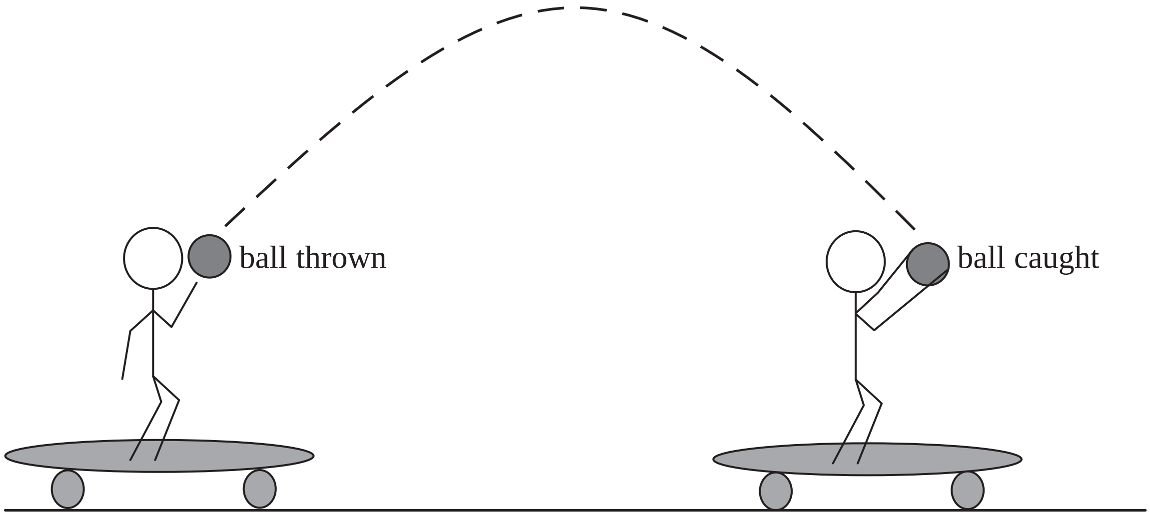
(Total for Question 11 = 4 marks)

***12** A skateboarder throws a ball vertically upwards, while travelling at a constant horizontal speed. The skateboarder catches the ball moments later whilst still moving horizontally.



Explain why the ball can be caught even though it was thrown vertically upwards and the skateboarder is moving horizontally. Ignore the effect of air resistance.

(4)

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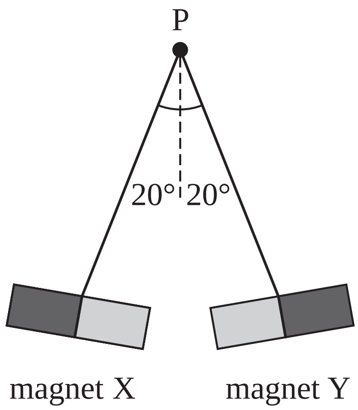
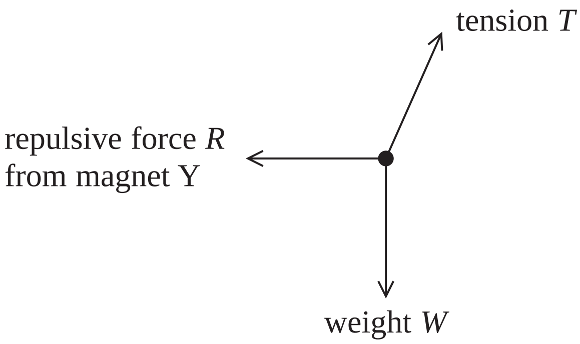
(Total for Question 12 = 4 marks)

13 Two identical magnets, X and Y, are suspended by a light thread from a point P. Like poles are placed next to one another and repel as shown below.



The free-body force diagram for magnet X is shown below.



(a) Show that T is about 0.2 N.

mass of bar magnet = 0.015 kg

(3)

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(b) Calculate the magnitude of R.

(3)

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R = ...

(c) State the magnitude of the repulsive force that magnet X exerts on magnet Y and justify your answer.

(2)

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(Total for Question 13 = 8 marks)

14 (a) A moving walkway transports people horizontally over a short distance.

A child stands on a walkway that is moving at a constant speed of 1.9 m s^{-1}. Halfway along the walkway the child turns around and attempts to walk back towards the start of the walkway at a steady speed of 1.9 m s^{-1}.

Explain why the child will not reach the start of the walkway.

(2)

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(b) Two floors in a building are connected by a stationary ramp at an angle of 15° to the horizontal and also by a staircase at an angle of 45° to the horizontal.

(i) A child walks up the ramp at a steady speed of 1.9 m s^{-1}, taking 25 s to reach the next floor.

Show that the work done by the child is about 5 kJ.

mass of child = 45 kg

(4)

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(ii) On another occasion, the child uses the staircase to reach the next floor in 12 s.

Calculate the power developed by the child as she uses the staircase.

(2)

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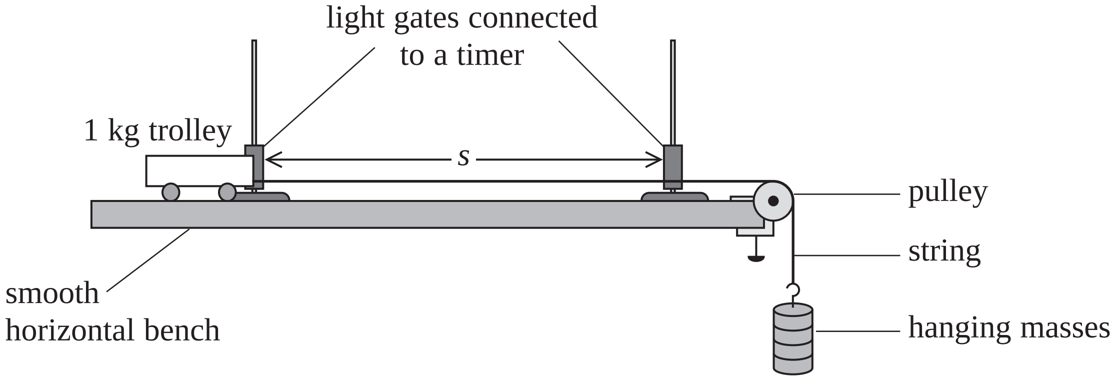
Power developed = ...

(Total for Question 14 = 8 marks)

15 In an investigation of how acceleration varies with force, a student used the apparatus shown in the diagram below.



Two light gates were positioned a distance *s* apart with the first gate at the start position of the trolley.

The student released the 1 kg trolley which was accelerated by the hanging masses. The trolley started a timer as it passed through the first light gate and stopped the timer as it passed through the second light gate. The student recorded the time *t* from the timer.

The procedure was repeated several times. Each time the student removed a mass *m* from the hanging masses and added it to the trolley, reducing the accelerating force.

A results table with the following columns was then completed.

Total hanging mass M / kg	Time t / s	Accelerating force F / N	Acceleration a / m s^{-2}

(a) (i) State how the student obtained a value for the accelerating force *F*.

(1)

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(ii) Explain how the student should calculate a value for the acceleration *a* of the trolley using *t*.

(2)

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(iii) Transferring a mass m from the hanging masses and adding it to the trolley means that the total mass being accelerated each time remains constant.

State why the total mass being accelerated should remain constant.

(1)

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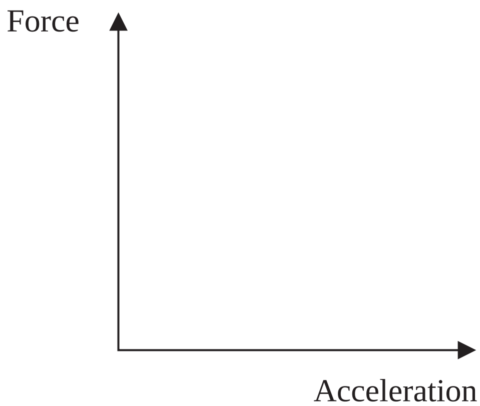
(b) (i) A graph is plotted of accelerating force against acceleration.

Sketch the graph you would expect the student to obtain.

(1)



(ii) State what quantity is represented by the gradient of the graph.

(1)

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(c) The time t could have been measured using a stopwatch.

Suggest **two** disadvantages of using a stopwatch rather than light gates and a timer to measure t.

(2)

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(Total for Question 15 = 8 marks)

16 In a hydroelectric power station, water drops through a vertical height from a reservoir turning a turbine. The turbine drives a generator to produce electricity. The photograph shows part of the hydroelectric power station at the Hoover Dam in the USA.

The reservoir contains fresh water.

(a) The total flow rate across all the turbines is 1060 $m^3 s^{-1}$.

(i) Show that the mass of water entering the turbines each second is about 1×10^6 kg.

density of fresh water = 997 kg m^{-3}

(2)

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(ii) On average the water will drop through a height of 185 m.

Show that the total power of the falling water before entering the turbines is about 2 GW.

(2)

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(iii) The turbines convert 80% of the power of the falling water into electrical power.

Calculate the amount of electrical energy the Hoover Dam produces each year.

(3)

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Electrical energy = ...

(iv) Suggest why not all of the power from the falling water is converted into electrical power.

(1)

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(b) Electrical energy could be produced in the same way using salt water. The viscosity of salt water is greater than the viscosity of fresh water.

Explain, without further calculation, why the different viscosity of the water would cause the power output using salt water to be less than the power output using fresh water.

(2)

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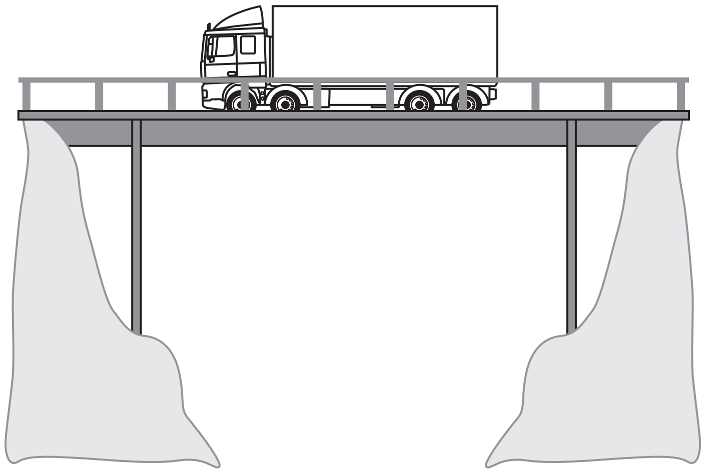
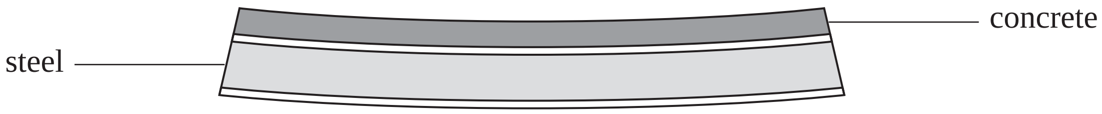
(Total for Question 16 = 10 marks)

17 A composite steel beam bridge is used across short spans.



A bridge beam consists of a base of steel with a layer of concrete on top. The diagram below shows how one of the beams will bend when a load is applied.



(a) (i) Label the diagram to show where the beam is under tension and under compression.

(2)

(ii) Explain the choice of materials used in the beam.

(2)

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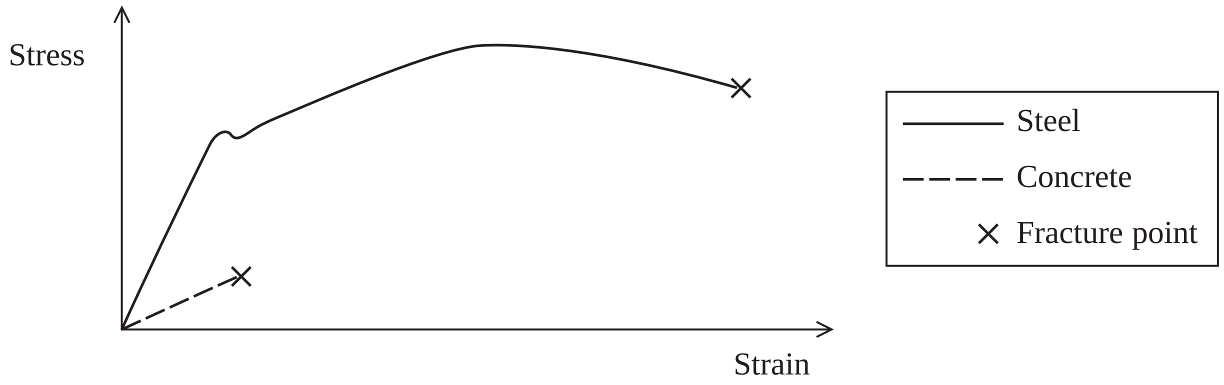
(b) The graph shows the tensile stress-strain curves for steel and concrete.



(i) State and define the property of concrete that causes it to break suddenly without warning.

(2)

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(ii) Use the graph to explain why there would be visible signs that the steel part of the bridge was starting to fail if the applied stress were too large.

(4)

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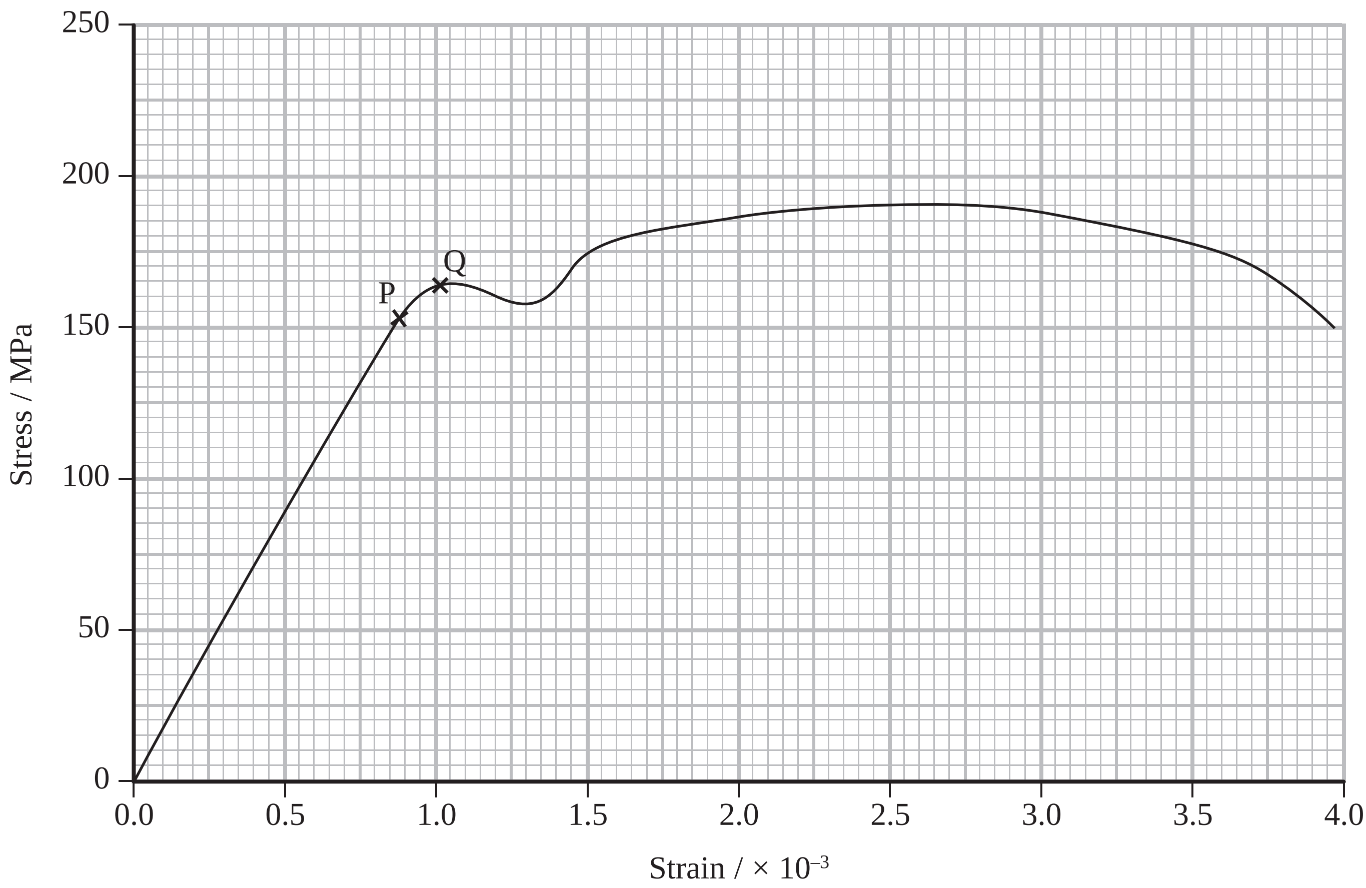
(c) A sample of steel was tested under large loads and the following stress-strain graph was plotted.



(i) Calculate the Young modulus of the steel.

(2)

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Young modulus = ...

(ii) Point P on the graph is the elastic limit of the steel sample and point Q is the yield point.

State what is meant by elastic limit and yield point.

(2)

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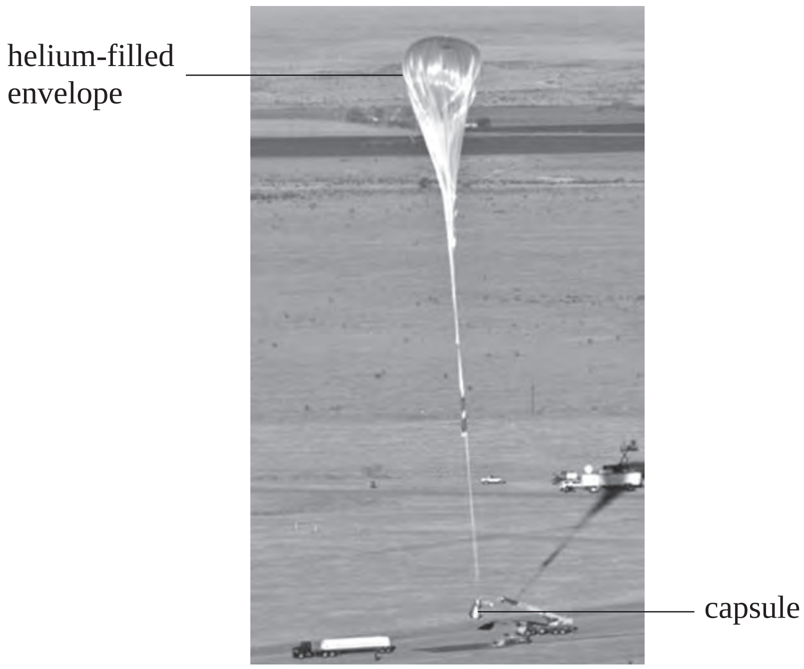
(Total for Question 17 = 14 marks)

18 In October 2012, Felix Baumgartner made a skydive from a height of almost 40 km above the Earth, making this the highest skydive on record.

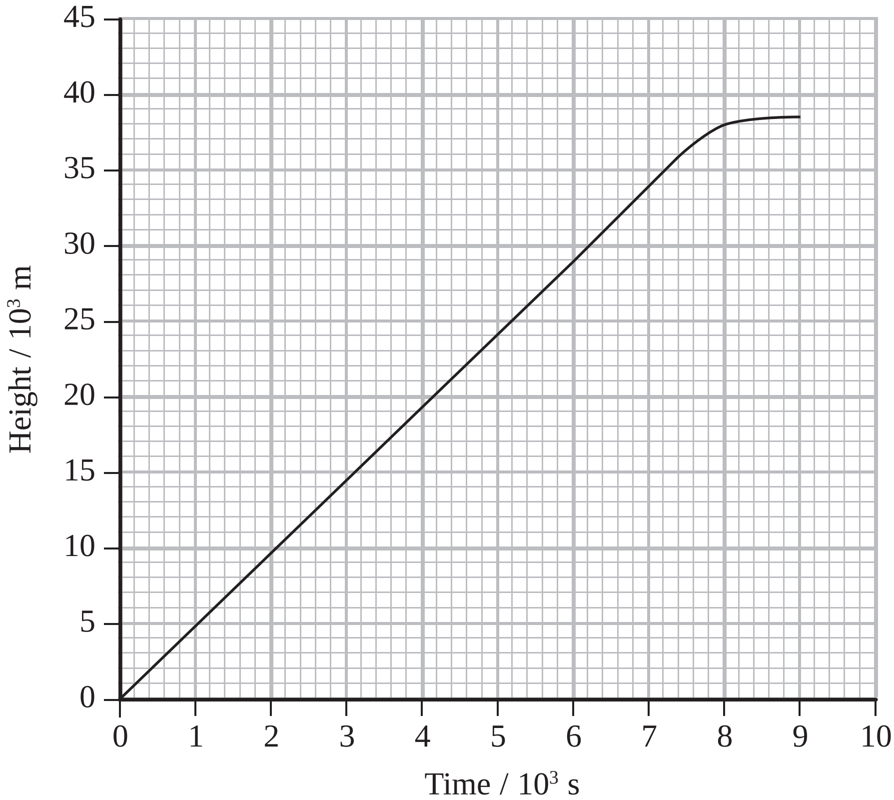
A balloon was used for the ascent. This consisted of a helium-filled envelope with a capsule attached to carry Baumgartner.



© Red Bull Stratos

The balloon rose to a height where the density of the air is less than 1/200 of its value at sea level. As the height increased the envelope expanded.

The graph below shows how the height of the balloon increased with time.



P 4 2 9 2 6 X A 0 2 4 2 8

(a) (i) Complete the free body force diagram below for the balloon as it rose. The total weight W of the balloon and Baumgartner has been added for you.

(2)

(ii) Write an expression for the forces acting on the balloon as it rose.

(1)

*(iii) When at the maximum height, the weight was equal to the upthrust.

Explain the changes in the upthrust as the balloon rose. Assume that the weight did not change.

(4)

(iv) Use the graph to calculate the velocity of the balloon as it rose.

(2)

Velocity = ...

(b) Once at the maximum height Baumgartner stepped out of the capsule and began to fall. Unlike previous record attempts, he exceeded the speed of sound whilst falling.

(i) Show that the theoretical speed he could have reached 50 seconds after stepping out of the capsule was about 500 m s^{-1}.

(2)

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(ii) The actual speed he reached 50 seconds after stepping out of the capsule was 380 m s^{-1}.

Account for the difference between the theoretical speed and the actual speed.

(1)

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(c) The Mach number is the ratio of the speed of an object to the speed of sound. The maximum speed reached by Baumgartner was 380 m s^{-1} at a height of 20 km above the Earth. This speed can be described as Mach 1.2.

Calculate the speed of sound in air at a height of 20 km.

(2)

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Speed of sound = ...

(Total for Question 18 = 14 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

List of data, formulae and relationships

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

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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