Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Thursday 11 October 2018

Morning (Time: 1 hour 30 minutes) | Paper Reference **WPH01/01**

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

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 on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 5 5 4 4 8 A 0 1 2 4

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 Which of the following quantities could have units of $\mathrm{N\,m\,s^{-1}}$?

☒ **A** gravitational field strength

☒ **B** gravitational potential energy

☒ **C** power

☒ **D** work done

(Total for Question 1 = 1 mark)

2 The equation $\Delta W = F\Delta s$ can be used to calculate the work done on an object by a force. Each quantity in the equation can be described as either vector or scalar.

Select the row from the table that correctly describes each of the quantities in this equation.

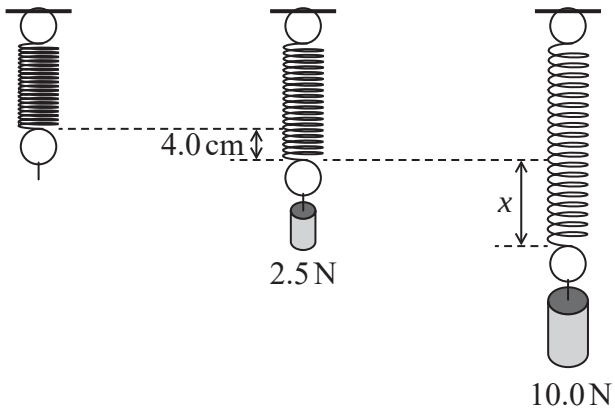
	ΔW	F	Δs
☒ **A**	scalar	vector	scalar
☒ **B**	scalar	vector	vector
☒ **C**	vector	vector	scalar
☒ **D**	vector	vector	vector

(Total for Question 2 = 1 mark)

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3 A spring is suspended from a bar. A load of 2.5 N is added to the free end of the spring and the spring extends by 4.0 cm.

The load is increased to 10.0 N and the spring extends by a further distance *x*.



What is the value of *x*?

☒ **A** 4.0 cm

☒ **B** 8.0 cm

☒ **C** 12.0 cm

☒ **D** 16.0 cm

(Total for Question 3 = 1 mark)

4 A student takes measurements to determine the density of a metal in the form of a long, thin wire.

Which of the following gives the equipment he should use?

☒ **A** Top pan balance, metre rule and micrometer

☒ **B** Top pan balance, metre rule and Vernier callipers

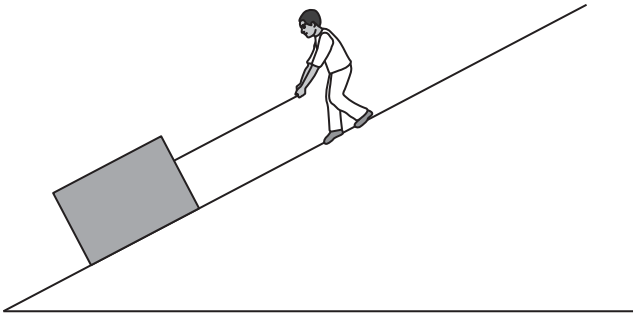
☒ **C** Top pan balance, micrometer and Vernier callipers

☒ **D** Top pan balance and Vernier callipers

(Total for Question 4 = 1 mark)

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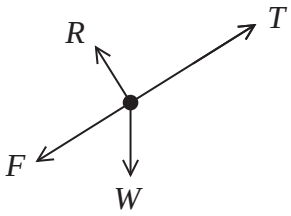
5 A box is pulled up a ramp using a rope as shown. The box moves at a constant speed.



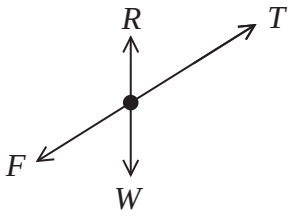
The forces acting on the box are:

W = weight of box
F = frictional force of ground on box
T = tension in rope
R = normal contact force of ground on box

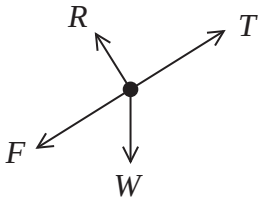
Select the diagram which represents the free-body force diagram for the box.



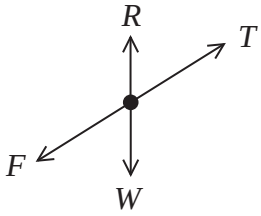
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 5 = 1 mark)

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Questions 6 and 7 refer to the experiment described below.

A student drops small solid spheres through a liquid of viscosity η in a measuring cylinder.

6 A small sphere of volume V falls at terminal velocity through the liquid.
A larger sphere of volume $8V$ is made of a different material. The larger sphere falls through the liquid at the same terminal velocity.

The frictional force acting on the small sphere is F.

Which of the following is the frictional force acting on the larger sphere?

☒ **A** $512F$

☒ **B** $8F$

☒ **C** $2F$

☒ **D** F

(Total for Question 6 = 1 mark)

7 If the liquid is cooled, the terminal velocity of the spheres would change.

The terminal velocity of the spheres would

☒ **A** decrease because η would decrease.

☒ **B** decrease because η would increase.

☒ **C** increase because η would decrease.

☒ **D** increase because η would increase.

(Total for Question 7 = 1 mark)

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Questions 8 and 9 refer to the information below.

A ball is dropped and is caught after the first bounce.

8 The ball takes 1.6 s to reach the ground.

From what height was the ball dropped?

☒ **A** 7.8 m

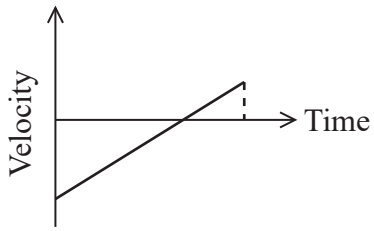
☒ **B** 13 m

☒ **C** 16 m

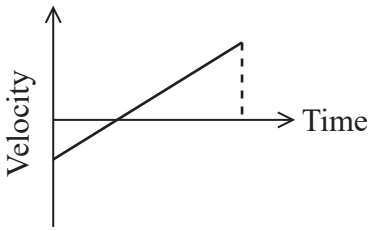
☒ **D** 25 m

(Total for Question 8 = 1 mark)

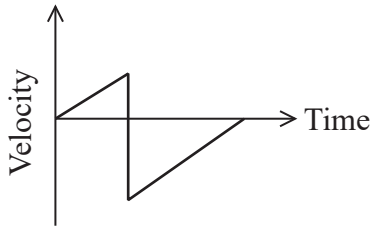
9 Which of the following is the velocity-time graph for the motion of the ball?



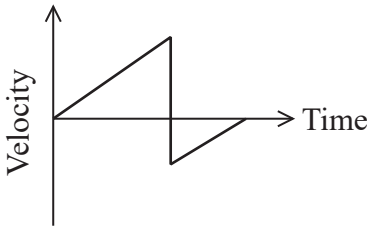
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 9 = 1 mark)

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10 Two liquids of different viscosities flow through identical pipes.

If the conditions are identical, the liquid with the lower viscosity will

☒ **A** flow at a lower speed and transfer a smaller volume of liquid per second.

☒ **B** flow at a higher speed and transfer a greater volume of liquid per second.

☒ **C** flow at a lower speed and transfer a greater volume of liquid per second.

☒ **D** flow at a higher speed and transfer a smaller volume of liquid per second.

(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) State what is meant by

(i) gravitational field strength

(1)

(ii) centre of gravity.

(1)

(b) The gravitational field strength on Earth is $9.81\,N\,kg^{-1}$.

Show that this results in an acceleration of free fall of $9.81\,m\,s^{-2}$.

(2)

(Total for Question 11 = 4 marks)

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12 Two students carry out experiments to measure the acceleration of free fall. In each experiment a ball bearing is dropped through a known distance and the time taken is measured.

Student A drops the ball bearing and starts a stopwatch. He stops the stopwatch when he sees the ball bearing reach the ground. The stopwatch measures to the nearest 0.01 s.

Student B uses an electronic system that releases the ball bearing and simultaneously starts a timer. The timer stops automatically when the ball bearing reaches a sensor. The timer measures to the nearest 0.001 s.

State and explain two reasons why the method used by Student B is better for this experiment.

(4)

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(Total for Question 12 = 4 marks)

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13 A crane is used to remove an object from the bottom of a lake.

The object is a cylinder of height h and the depth of the lake is D, as shown in Figure 1.

The cylinder is moved vertically through the water at a slow and steady speed. The cylinder comes to rest in a position where it is completely above the surface of the water, as shown in Figure 2.

The diagrams are not to scale.

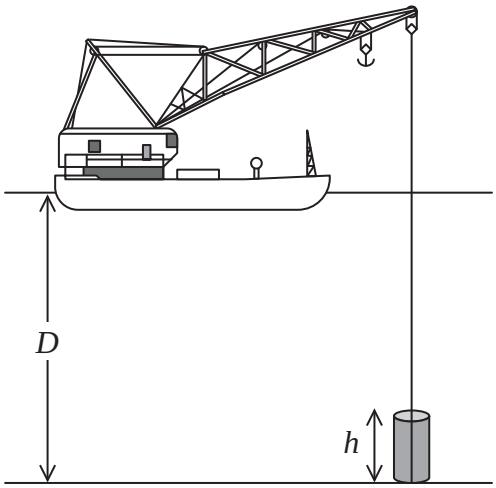


Figure 1

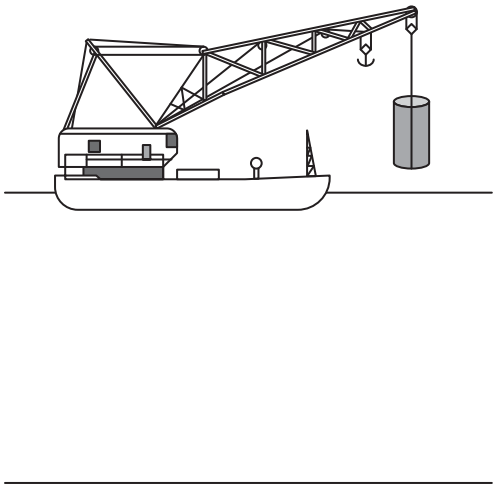
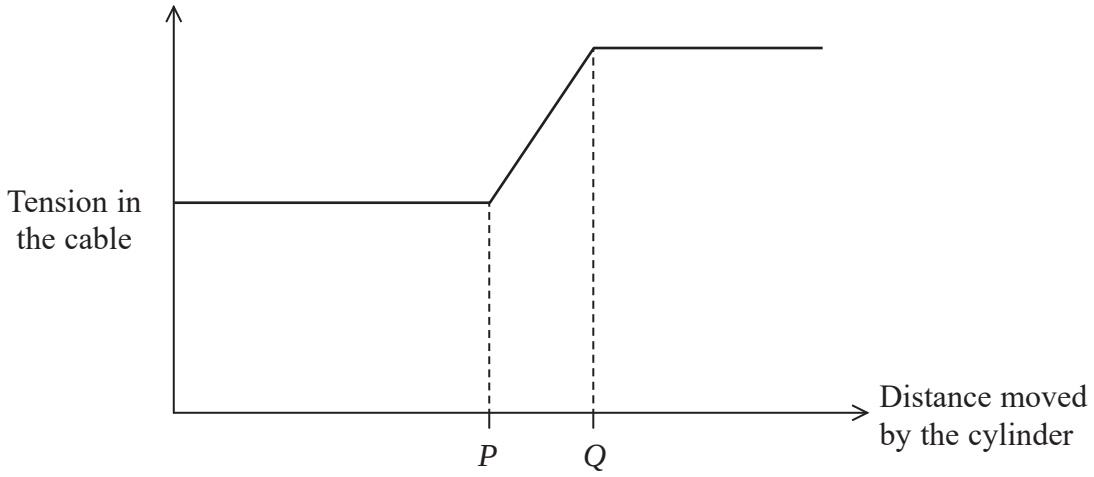


Figure 2

The graph shows how the tension in the cable varies with distance as the cylinder is lifted from the bottom of the lake to its position in Figure 2.



(a) State expressions for the distances P and Q.

(2)

Distance P = ...

Distance Q = ...

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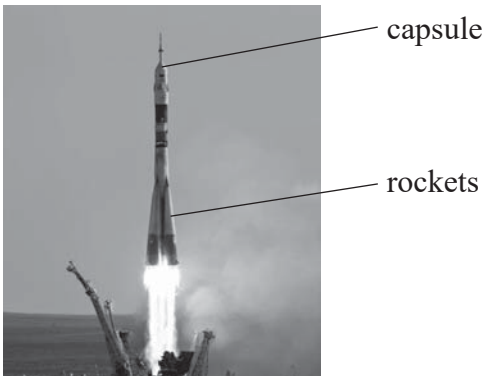
*(b) Explain the shape of the graph.

(5)

(Total for Question 13 = 7 marks)

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14 Soyuz spacecraft are used to carry crew and supplies to the International Space Station. The spacecraft consists of rockets, fuel tanks and a capsule to carry crew and supplies.



Nostalgia for Infinity/Shutterstock©

(a) During take-off combustion produces hot gases at very high pressure. The gases expand and move downwards out of the rocket.

Explain how this enables the spacecraft to accelerate away from the ground.

(2)

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(b) As the spacecraft takes off, the apparent weight of a crew member is 3700 N.

Determine the acceleration of the spacecraft.

mass of crew member = 81 kg

(4)

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Acceleration = ...

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(c) As each fuel tank becomes empty, the tank and its associated rocket are detached from the spacecraft and fall back towards the Earth.

Explain why this is done.

(2)

(d) When the capsule returns from the International Space Station, parachutes are used to reduce the speed of the capsule as it nears the surface of the Earth.

Explain how the parachutes reduce the speed of the capsule.

(3)

(Total for Question 14 = 11 marks)

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15 Two projectiles, A and B, are launched from position O at the same time. At time t, both projectiles have travelled a horizontal distance OP as shown.

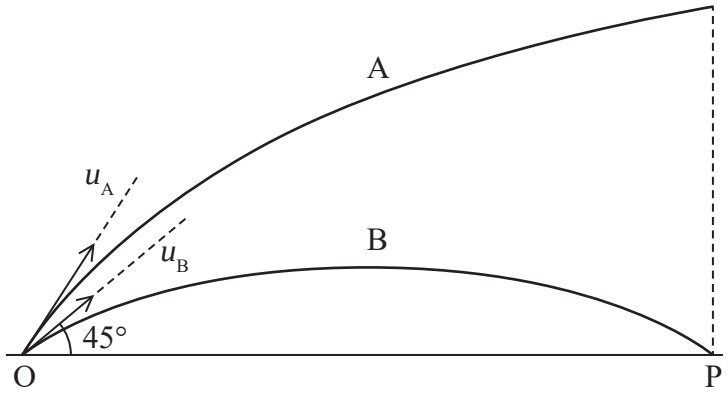


Diagram not to scale

Projectile A is launched with a velocity u_A at an angle of θ to the horizontal and projectile B is launched with a velocity u_B at 45° to the horizontal.

(a) (i) Show that u_A may be expressed in terms of u_B as

$$u_A = \frac{0.707u_B}{\cos\theta}$$

(3)

(ii) Explain why, for the paths of the two projectiles to be as shown, $u_A > u_B$.

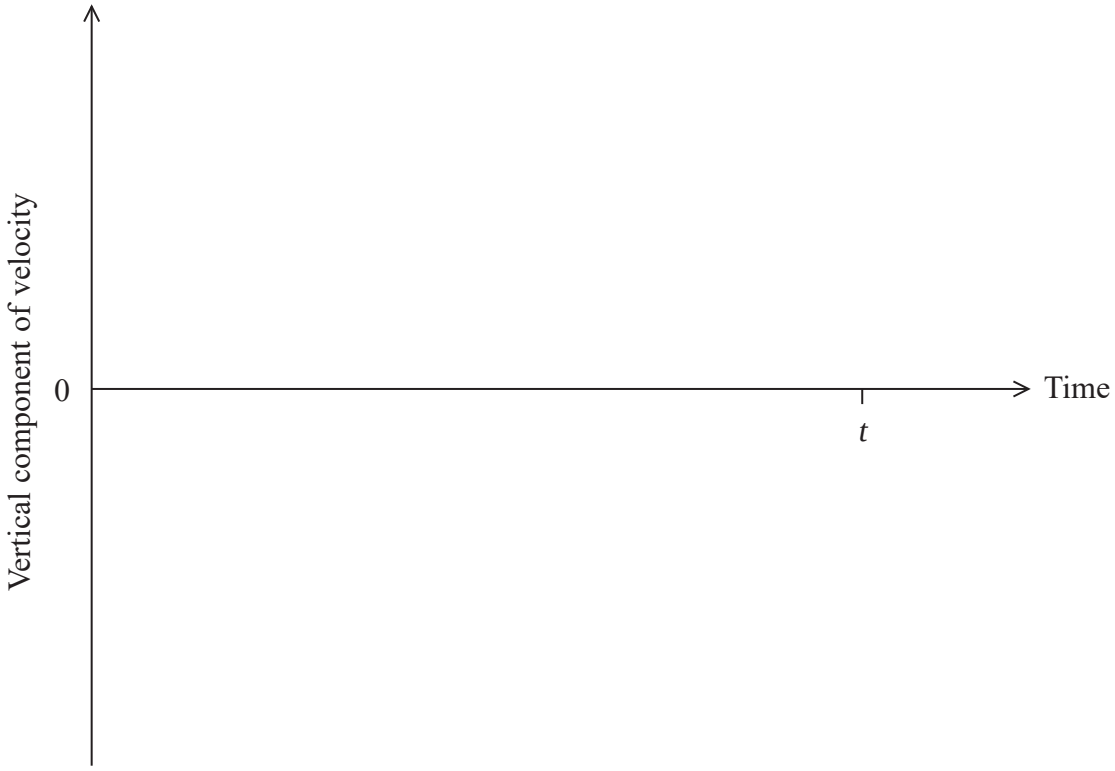
(2)

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(b) On the axes below sketch labelled graphs for the vertical component of velocity against time for the motion of projectile A and projectile B between O and P.

You may ignore the effects of air resistance.

(4)



(Total for Question 15 = 9 marks)

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***16** (a) Rain consists of droplets of water of different sizes.

Explain why larger droplets of rain reach the ground more quickly. You may assume that the upthrust acting on a rain droplet is negligible.

(4)

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(b) Rain is falling vertically through the air with a velocity of $8.5\,m\,s^{-1}$. Due to the wind, the air is moving horizontally at a speed of $12.0\,m\,s^{-1}$, moving the rain with it.

(i) Draw a scaled and labelled vector diagram for a raindrop.

(3)

(ii) Hence determine the resultant velocity of the rain.

(2)

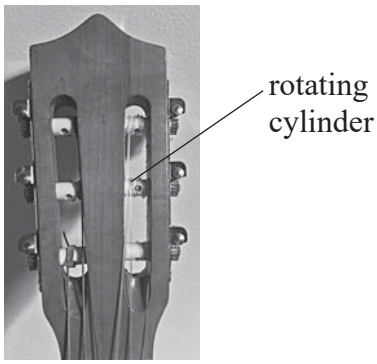
Magnitude of the resultant velocity of the rain = ...

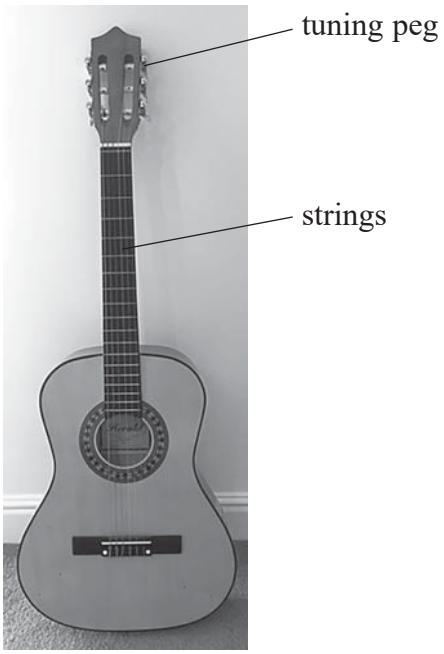
Direction of the rain = ...

(Total for Question 16 = 9 marks)

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17 A guitar produces sound by making a series of strings vibrate. To produce the correct frequency of sound, the tension in each string must first be adjusted by turning a tuning peg attached to a rotating cylinder.





(a) A new string is attached to the guitar and wound around the rotating cylinder until the string just begins to tighten.

(i) The original length of the string is 0.60 m. The rotating cylinder is turned by adjusting the tuning peg, until the tension in the string is 190 N.

Show that the string will extend by about 8 mm.

(4)

diameter of string = 3.3×10^{-4} m
Young modulus of material of the string = 170 GPa

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(ii) The rotating cylinder has a diameter of 9.2×10^{-3} m.

Calculate the number of turns of the rotating cylinder that are required to produce this extension.

(2)

Number of turns of the rotating cylinder = ...

(b) It is important that guitar strings have a high elastic limit.

(i) State what is meant by the term elastic limit.

(1)

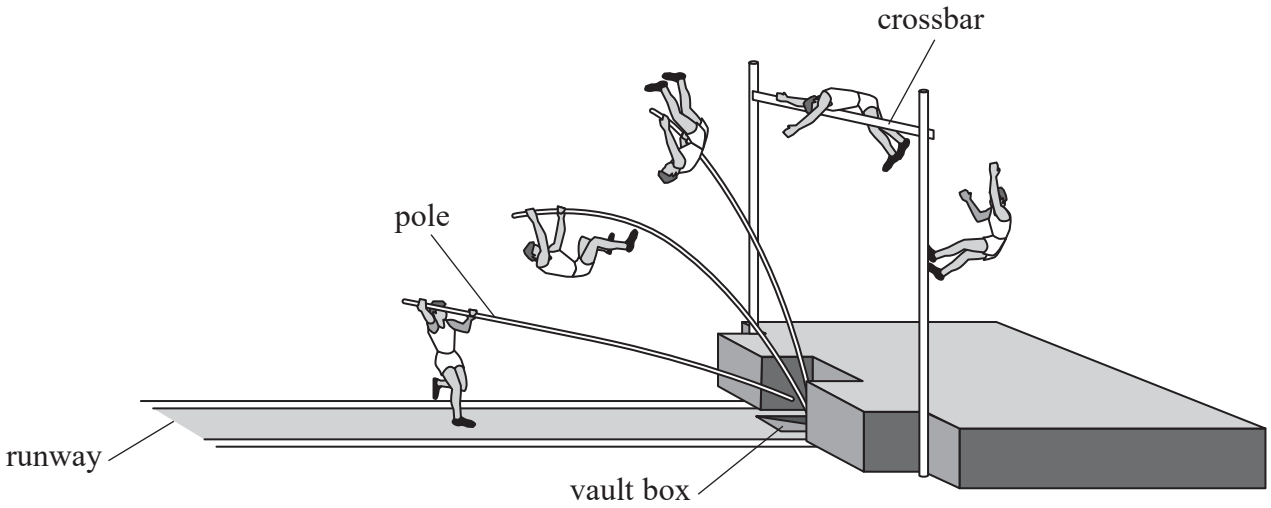
(ii) Explain why the guitar strings should have a high elastic limit.

(3)

(Total for Question 17 = 10 marks)

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18 In the sport of pole vaulting, a long flexible pole is used to lift the athlete up over a crossbar, as shown in the diagram.



The athlete runs down the runway at high speed and places the end of the pole in the vault box. The pole bends then straightens, moving the athlete upwards. At the maximum height the athlete lets go of the pole.

(a) Explain how using the pole enables the athlete to reach a greater height than by jumping.

Your answer should be in terms of the energy transfers involved.

(3)

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(b) An athlete reaches a maximum speed of $9.4\,m\,s^{-1}$ before placing the pole in the vault box.

You may neglect frictional forces, and any work done by the athlete's muscles after the pole enters the vault box.

(i) The athlete has a horizontal velocity of $1.1\,m\,s^{-1}$ at the maximum height.

Calculate the maximum possible change in height of the athlete's centre of gravity.

(4)

Maximum change in height = ...

(ii) Consider the pole to behave as a spring of stiffness $850\,N\,m^{-1}$. The distance between the two ends of the pole decreases by a maximum of 2.1 m during the jump.

Calculate the maximum proportion of the initial kinetic energy stored in the pole.

(5)

mass of athlete = 78 kg

Maximum proportion of initial kinetic energy = ...

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(c) State and explain two properties that should be considered when selecting a material for the pole.

(4)

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(Total for Question 18 = 16 marks)

TOTAL FOR SECTION B = 70 MARKS
TOAL FOR PAPER = 80 MARKS

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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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