OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL
PHYSICS
(9630)

PAPER 1

Specimen 2018 Morning Time allowed: 2 hours

Materials
For this paper you must have:
- a pencil
- a ruler
- a calculator
- a data and formula booklet.

Instructions
- use black ink or ball-point pen
- answer **all** questions
- show all your working.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80 marks.

Please write clearly in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

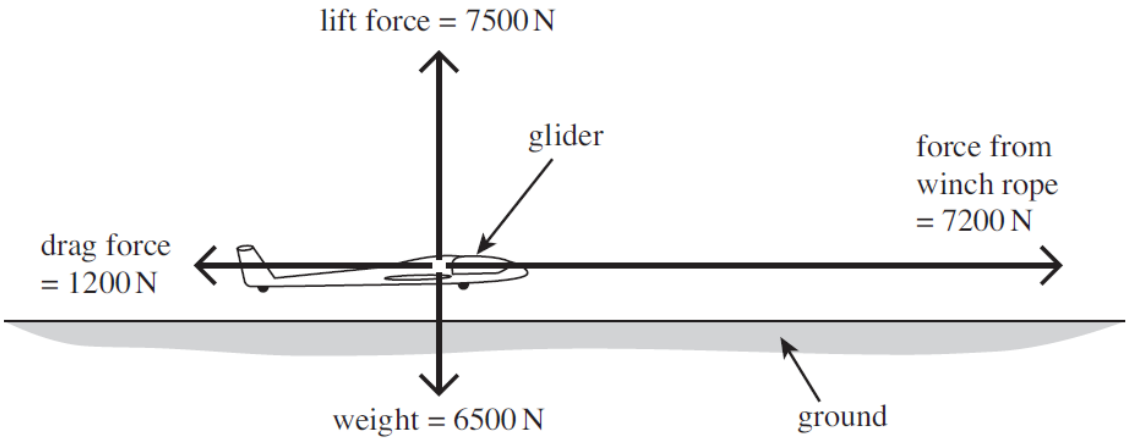
Candidate signature _____

Section A

Answer **all** questions in this section.

0 1 Gliders can be launched using a machine that pulls a rope attached to the glider. **Figure 1** shows the forces acting on the glider at one instant during the launch.

Figure 1



The combined weight of the glider and pilot is 6500 N.

0 1 . 1 Show that the magnitude of the resultant force acting on the glider is approximately 6100 N.

[2 marks]

0 1 . 2 Determine the angle from the horizontal of the resultant force acting on the glider.

[2 marks]

angle = _____ degrees

0 2 An engineer tests a car by measuring the time taken for it to travel 1500 m at a constant speed. When delivering its maximum output power of 35 kW the time recorded is 28 s.

0 2 . 1 Calculate the magnitude of the resistive force that is acting on the car.

[2 marks]

resistive force = _____ N

0 2 . 2 Identify **one** way in which the engineer could modify the car so that the time to cover the test distance is reduced.

[1 mark]

_____

_____

0 3 A neutron decays by emitting a β^- particle.

0 3 . 1 Identify the other particle that is emitted in the decay.

[1 mark]

_____

0 3 . 2 Describe what happens the electron and a positron collide.

[2 marks]

_____

_____

_____

_____

0 4 A radioactive nucleus decays with the emission of an alpha particle.

Describe the changes that occur in the proton number and the nucleon number of the nucleus.

[2 marks]

Proton number _____

Nucleon number _____

0 5 . 1 Compare the relative penetrating powers of alpha and gamma radiation.

[1 mark]

0 5 . 2 Gamma rays from a point source are travelling towards a detector.
The distance from the source to the detector is changed from 1.0 m to 3.0 m.

[2 marks]

Calculate the ratio $\frac{\text{intensity of radiation at 3.0 m}}{\text{intensity of radiation at 1.0 m}}$

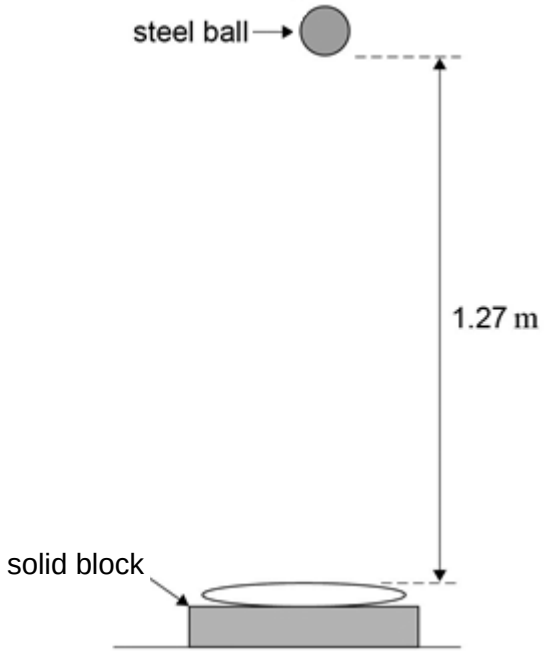
ratio = _____

0 6 Spectacle lenses may be tested for shock resistance by dropping a small steel ball onto the lens, as shown in **Figure 2**, and then checking the lens for damage.

Figure 2

mass of steel ball = 16 g

height of drop = 1.27 m



0 6 . 1 Calculate the speed of the ball just before impact.
Ignore the effects of air resistance in this question.

[2 marks]

speed before impact = _____ $\mathrm{m\ s^{-1}}$

0 6 . 2 In a test the ball bounced back to a height of 0.85 m.

Calculate the speed of the ball just after impact.

[2 marks]

speed after impact = _____ $\mathrm{m\ s^{-1}}$

0 6 . 3 Calculate the change in momentum of the ball due to the impact.

[2 marks]

momentum = _____ $\mathrm{kg\ m\ s^{-1}}$

Question 6 continues on the next page

0 6 . 4 The time of contact was 40 ms.

Calculate the average force exerted by the ball on the lens during the impact.

[1 mark]

average force = _____ N

0 6 . 5 Explain, with reference to momentum, why the test should also specify the material of the solid block the lens sits on.

[2 marks]

_____

_____

_____

_____

0 7 Metal railway tracks expand when the weather becomes warmer. Therefore, when rails are laid in cold weather they are stretched and fixed into place while still stretched to avoid them deforming. This is called pre-straining.

The following data is typical for a length of steel rail:

Young modulus of steel =	2.0×10^{11} Pa
cross-sectional area of a length of rail =	7.5×10^{-3} m^2
amount of pre-strain =	2.5×10^{-5} for each kelvin rise in temperature the rail is expected to experience.

A steel rail is laid when the temperature is 8 °C and an engineer decides to use a pre-strain of 3.0×10^{-4}.

0 7 . 1 Calculate the tensile force required to produce the pre-strain in the rail required by the engineer.

[3 marks]

tensile force = _____ N

0 7 . 2 Calculate the elastic strain energy stored in a rail of unstressed length 45 m when pre-strained as in Question **7.1**.

[2 marks]

elastic strain energy = _____ J

Question 7 continues on the next page

0 7 . 3 Calculate the temperature when there is **no** stress in the steel rail.

[2 marks]

temperature = _____ °C

0 7 . 4 Explain why the engineer does **not** use the highest observed temperature at the location of the railway track to determine the amount of pre-strain to use.

[2 marks]

_____

_____

_____

_____

0 8 A climber falls 2.3 m before being stopped by his climbing rope that is secured above him.
The weight of the climber is 840 N.

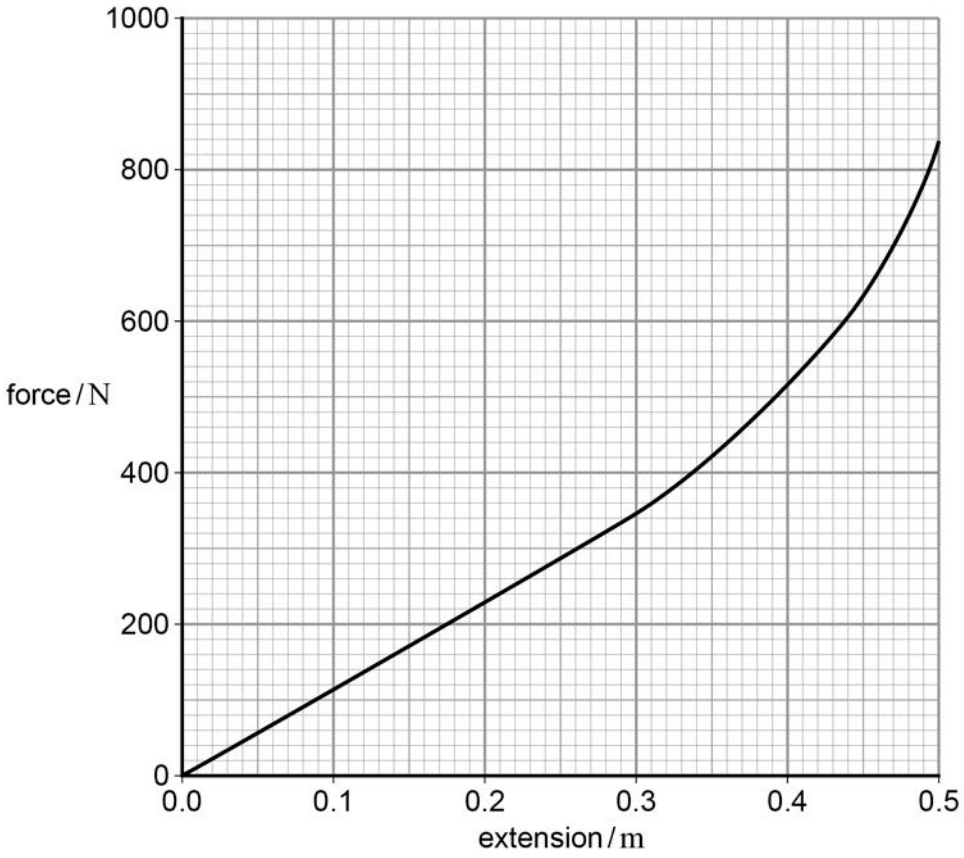
0 8 . 1 Calculate the loss in gravitational potential energy of the climber.

[2 marks]

loss in potential energy = _____ J

Figure 3 shows a force-extension graph for the rope being used.

Figure 3



0 8 . 2 Determine the stiffness of the rope when it is being used with forces up to 350 N. Give the appropriate unit.

[2 marks]

stiffness = _____ unit = _____

0 8 . 3 Determine the energy stored in the rope when it is stretched by 0.45 m.

[3 marks]

energy = _____ J

0 9 **Table 1** shows information for two isotopes of uranium. The table is incomplete.

Table 1

	number of protons	number of neutrons	specific charge of nucleus / ……
first isotope	92	143	
second isotope			3.72×10^7

0 9 . 1 Explain what is meant by isotopes.

[2 marks]

0 9 . 2 Write the unit for the specific charge in the heading of the last column of **Table 1**.

[1 mark]

0 9 . 3 Write down the number of protons in the second isotope in **Table 1**.

[1 mark]

0 9 . 4 Calculate the specific charge of the nucleus of the first isotope.

[3 marks]

specific charge = _____

0 9 . 5 Calculate the number of neutrons in the nucleus of the second isotope.

[3 marks]

number of neutrons = _____

Turn over for the next question

Section B

Answer **all** questions in this section.

1 0 **Table 2** gives the values for the activity of a radioactive isotope over a time interval of several seconds.

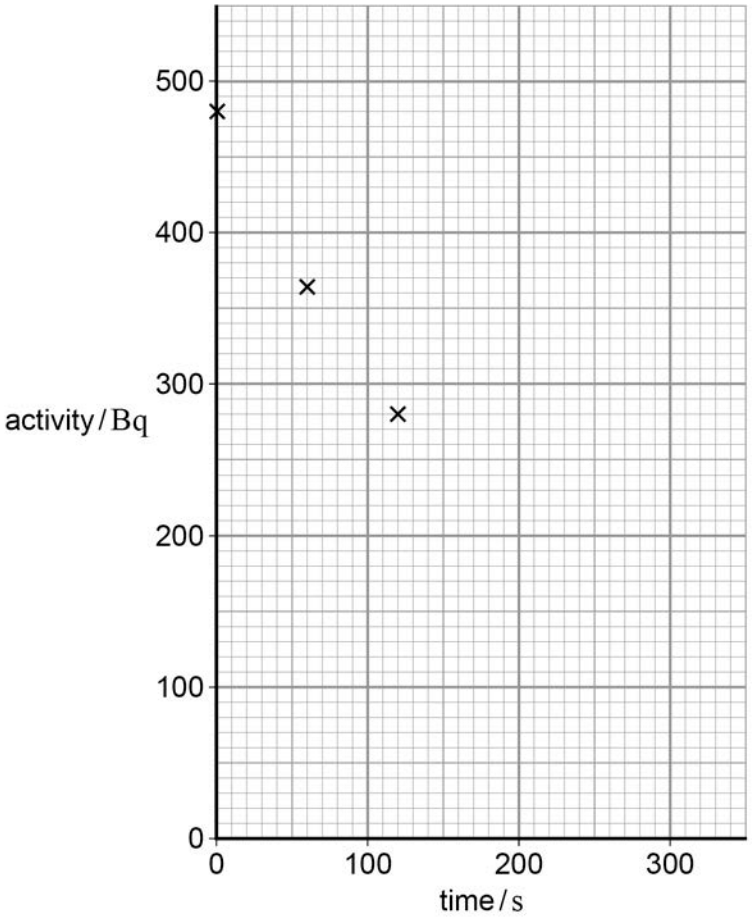
Table 2

time / s	0	60	120	180	240	300
activity / Bq	480	366	280	214	163	124

1 0 . 1 Complete the graph in **Figure 4** by plotting the remaining points and drawing an appropriate curve.

[2 marks]

Figure 4



1 0 . 2 Use the graph to determine the half-life of the isotope.

[2 marks]

half-life = _____ s

Turn over for the next question

Data analysis question

1 1 Capillary action can cause a liquid to rise up a hollow tube. **Figure 5** shows water that has risen to a height h in a narrow glass tube because of capillary action.

Figure 5

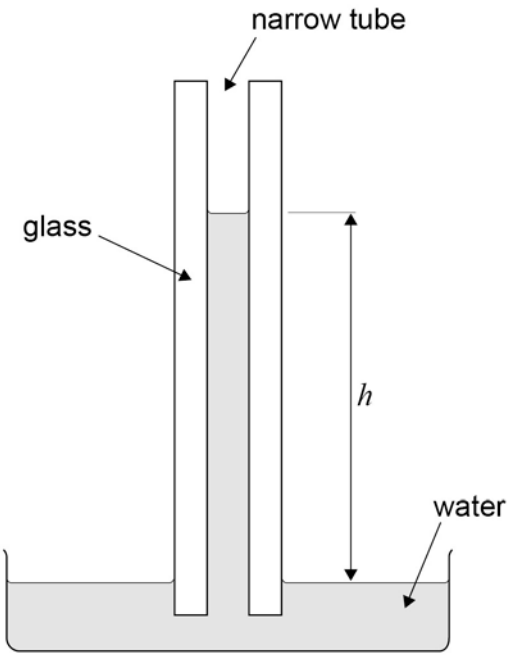
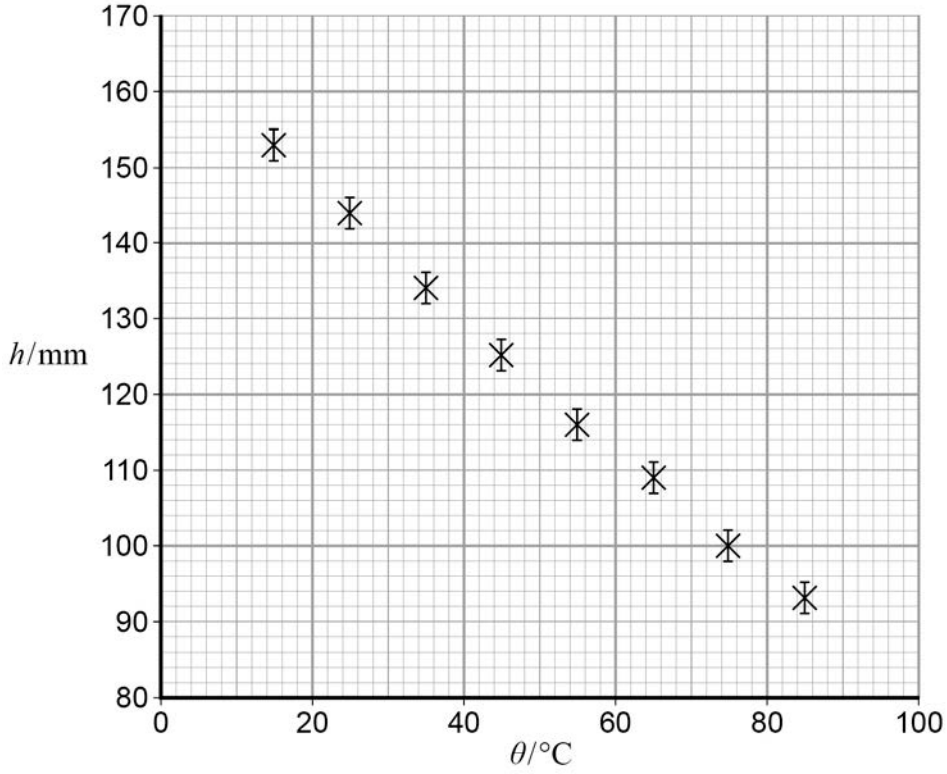


Figure 6 shows the variation of h with temperature θ for this particular tube.

Figure 6



The uncertainty in the measurement of h is shown by the error bars. Uncertainties in the measurements of temperature are negligible.

1 1 . 1 Draw a best-fit line for these data (**Figure 6**).

[2 marks]

1 1 . 2 It is suggested that the relationship between h and θ is

$$h = h_0 - (h_0 k)\theta$$

where h_0 and k are constants.

Determine h_0.

[2 marks]

h_0 = _____ mm

1 1 . 3 Show that the value of $h_0 k$ is about 0.9 mm K^{-1}.

[3 marks]

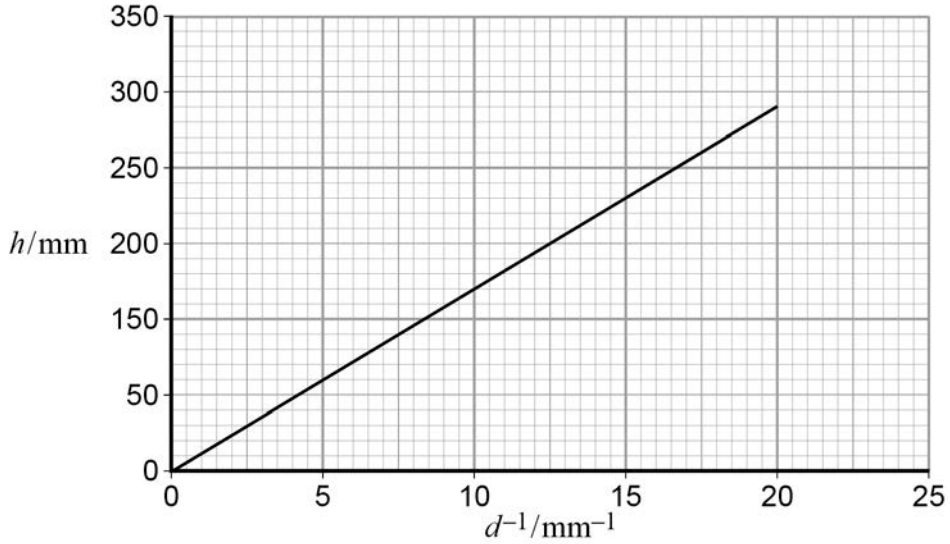
1 1 . 4 Determine k. State a unit for your answer.

[2 marks]

k = _____ unit = _____

1 1 . 5 A similar experiment is carried out at constant temperature with tubes of varying internal diameter d. **Figure 7** shows the variation of h with $\frac{1}{d}$ at a constant temperature.

Figure 7



It is suggested that capillary action moves water from the roots of a tree to its leaves.

The gradient of **Figure 7** is 14.5 mm^2.

The distance from the roots to the leaves at the top of the tree is 8.0 m.

Calculate the internal diameter of the tubes required to move water from the roots to the leaves at the top of the tree by capillary action.

[2 marks]

internal diameter = _____ mm

1 1 . 6 Comment on the accuracy of your answer for the internal tube diameter in Question **11.5**.

[1 mark]

Section C

Each of the questions in this section is followed by four responses, **A**, **B**, **C**, and **D**. For each question select the best response.

Only **one** answer per question is allowed.

For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD  WRONG METHODS 

If you want to change your answer you must cross out your original answer as shown. 

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

1 2 Which of the following is a scalar quantity?

[1 mark]

A force

B kinetic energy

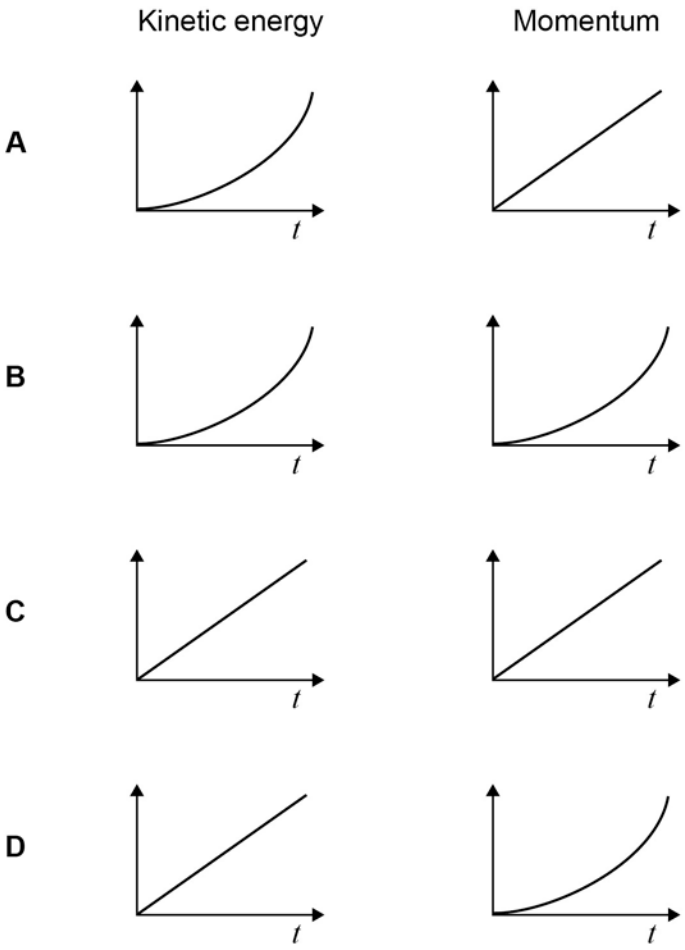
C momentum

D velocity

Turn over for the next question

1 3 An object is accelerated from rest by a constant force F for a time t.
Which graphs represent the variation of time with the change in the kinetic energy and the change in momentum of the object?

[1 mark]



A ⬭

B ⬭

C ⬭

D ⬭

1 4 An object is dropped from a cliff. How far does the object fall in the third second?
Assume that $g = 10\ \text{m s}^{-2}$.

[1 mark]

A 10 m ⬭

B 20 m ⬭

C 25 m ⬭

D 45 m ⬭

1 5 A body falls freely, with negligible air resistance. Which quantity is its rate of change of momentum?

[1 mark]

A kinetic energy ⬭

B mass ⬭

C power ⬭

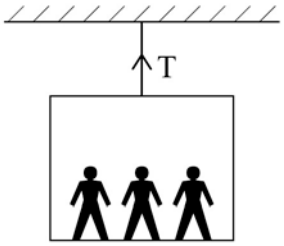
D weight ⬭

1 6 A firework rocket is fired vertically into the air and explodes at its highest point. What are the changes to the total kinetic energy of the rocket and the total momentum of the rocket as a result of the explosion?

[1 mark]

	total kinetic energy of rocket	**total momentum of rocket**	
A	unchanged	unchanged	⬭
B	unchanged	increased	⬭
C	increased	unchanged	⬭
D	increased	increased	⬭

1 7 A lift and its passengers with a total mass of 500 kg accelerates upwards at $2\ \text{m s}^{-2}$ as shown. Assume that $g = 10\ \text{m s}^{-2}$.



What is the tension in the cable?

[1 mark]

A 1000 N ⬭

B 4000 N ⬭

C 5000 N ⬭

D 6000 N ⬭

1 8 Which of the following is **not** a unit of power?

[1 mark]

A $\mathrm{N\ m\ s^{-1}}$ ⬭

B $\mathrm{kg\ m^{2}\ s^{-3}}$ ⬭

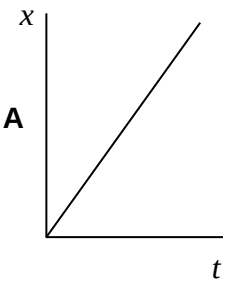
C $\mathrm{J\ s^{-1}}$ ⬭

D $\mathrm{kg\ m^{-1}\ s^{-1}}$ ⬭

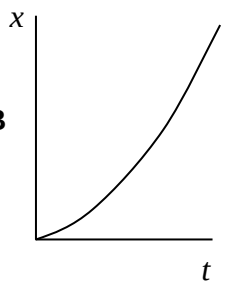
1 9 A car accelerates uniformly from rest along a straight road. Which graph shows the variation of displacement x of the car with time t?

[1 mark]

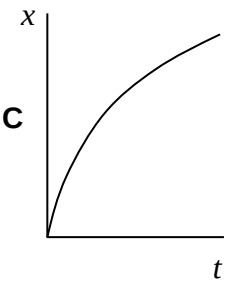
A



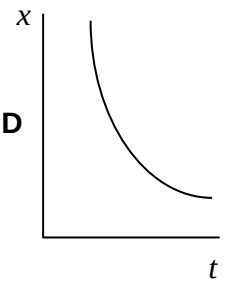
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

2 0 Which of the following statements is correct?

[1 mark]

The force acting on an object is equivalent to:

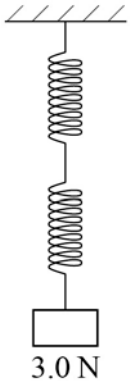
A its change of momentum. ⬭

B the impulse it receives per second. ⬭

C the energy it gains per second. ⬭

D its acceleration per metre. ⬭

2 1 A load of 3.0 N is attached to a spring of negligible mass and spring constant 15 $\mathrm{N\ m^{-1}}$.



What is the energy stored in the spring?

[1 mark]

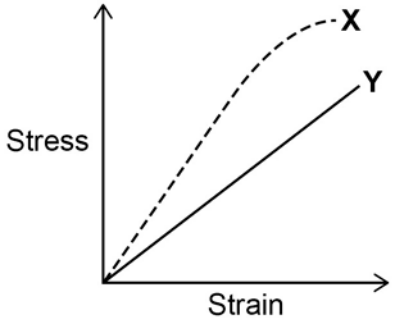
A 0.3 J ⬭

B 0.6 J ⬭

C 0.9 J ⬭

D 1.2 J ⬭

2 2 The diagram shows how the stress varies with strain for metal specimens X and Y which are different. Both specimens were stretched until they broke.



Which of the following is **not** correct?

[1 mark]

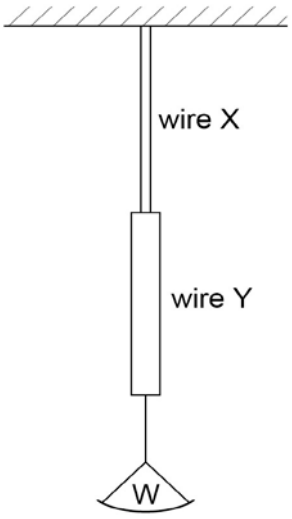
A X is stiffer than Y ⬭

B X has a higher value of the Young modulus ⬭

C X is more brittle than Y ⬭

D Y has a lower maximum tensile stress than X ⬭

2 3 Two vertical copper wires X and Y of equal length are joined as shown. Y has a greater diameter than X. A weight W is hung from the lower end of Y.



Which of the following is correct?

[1 mark]

A The strain in X is the same as that in Y ⬭

B The stress in Y is greater than that in X ⬭

C The tension in Y is the same as that in X ⬭

D The elastic energy stored in X is less than that stored in Y ⬭

2 4 What is the relationship between the distance y travelled by an object falling freely from rest and the time x the object has been falling?

[1 mark]

A y is proportional to x^2 ⬭

B y is proportional to $\sqrt{x}$ ⬭

C y is proportional to $\frac{1}{x}$ ⬭

D y is proportional to $\frac{1}{x^2}$ ⬭

2 5 When an unstable nucleus, ${}^{A}_{Z}\mathrm{X}$, decays by emitting a β^- particle

CHECK QUESTION

[1 mark]

A A increases by 1, Z remains the same ⬭

B A decreases by 1, Z remains the same ⬭

C A remains the same, Z increases by 1 ⬭

D A remains the same, Z decreases by 1 ⬭

END OF QUESTIONS

There are no questions printed on this page

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