Surname:	**First Name:**

Current School:

Shrewsbury School

SHREWSBURY SCHOOL

SIXTH FORM ENTRANCE EXAMINATION
2025 ENTRY

PHYSICS

(1 Hour)

Instructions to candidates:

- Please answer all questions. Calculators may be used.
- Questions 1-30 are multiple choice: **record your answers in the grid provided.**
- **Be sure to leave about 20 minutes for section B**: these should be answered in the spaces provided in the booklet.

Assume g = 9.8 m/s^2 unless otherwise stated.

Useful Equations

Word equation	Symbol equation
weight = mass × gravitational field strength (g)	$W = m\,g$
work done = force × distance (along the line of action of the force)	$W = F\,s$
force applied to a spring = spring constant × extension	$F = k\,e$
moment of a force = force × distance (normal to direction of force)	$M = F\,d$
pressure = $\frac{\text{force normal to a surface}}{\text{area of that surface}}$	$p = \frac{F}{A}$
distance travelled = speed × time	$s = v\,t$
acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{\Delta v}{t}$
resultant force = mass × acceleration	$F = m\,a$
momentum = mass × velocity	$p = m\,v$
kinetic energy = 0.5 × mass × (speed)^2	$E_k = \frac{1}{2}m\,v^2$
gravitational potential energy = mass × gravitational field strength (g) × height	$E_p = m\,g\,h$
power = $\frac{\text{energy transferred}}{\text{time}}$	$P = \frac{E}{t}$
power = $\frac{\text{work done}}{\text{time}}$	$P = \frac{W}{t}$
efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	
wave speed = frequency × wavelength	$v = f\,\lambda$
charge flow = current × time	$Q = I\,t$
potential difference = current × resistance	$V = I\,R$
power = potential difference × current	$P = V\,I$
power = (current)^2 × resistance	$P = I^2\,R$
energy transferred = power × time	$E = P\,t$
energy transferred = charge flow × potential difference	$E = Q\,V$
density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$

Name: ……

Circle your answers for Section A:

Q.1	A	B	C	D
Q.2	A	B	C	D
Q.3	A	B	C	D
Q.4	A	B	C	D
Q.5	A	B	C	D
Q.6	A	B	C	D
Q.7	A	B	C	D
Q.8	A	B	C	D
Q.9	A	B	C	D
Q.10	A	B	C	D
Q.11	A	B	C	D
Q.12	A	B	C	D
Q.13	A	B	C	D
Q.14	A	B	C	D
Q.15	A	B	C	D
Q.16	A	B	C	D
Q.17	A	B	C	D
Q.18	A	B	C	D
Q.19	A	B	C	D
Q.20	A	B	C	D
Q.21	A	B	C	D
Q.22	A	B	C	D
Q.23	A	B	C	D
Q.24	A	B	C	D
Q.25	A	B	C	D
Q.26	A	B	C	D
Q.27	A	B	C	D
Q.28	A	B	C	D
Q.29	A	B	C	D
Q.30	A	B	C	D

Section A - 30 marks: Attempt all questions.

1

A train begins a journey from a station and travels 60 km in a time of 20 minutes.

What is the average speed of the train?

A 3.0 m/s **B** 5.0 m/s **C** 50 m/s **D** 60 m/s

2

A large stone is dropped from a bridge into a river. Air resistance can be ignored.

Which row describes the acceleration and the speed of the stone as it falls?

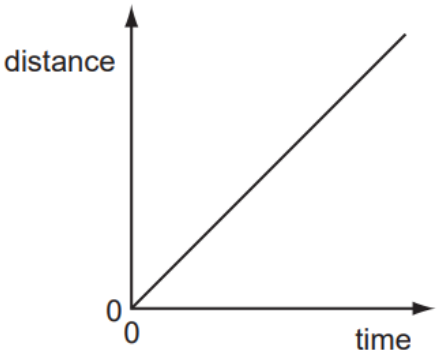
	acceleration of the stone	speed of the stone
A	constant	constant
B	constant	increasing
C	increasing	constant
D	increasing	increasing

3

Two distance-time graphs and two speed-time graphs are shown.

Which graph represents an object that is at rest?

A



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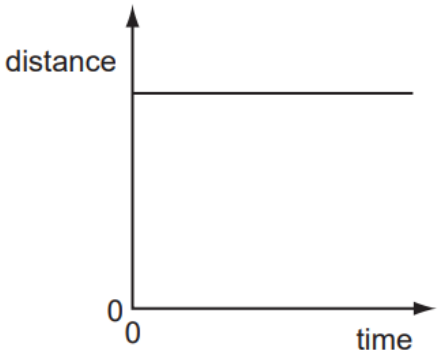

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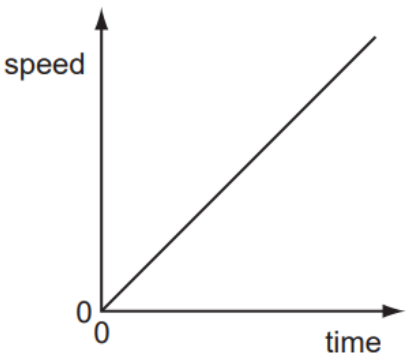

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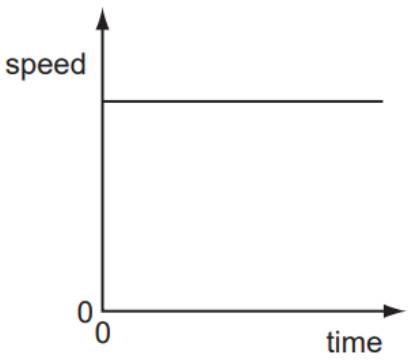


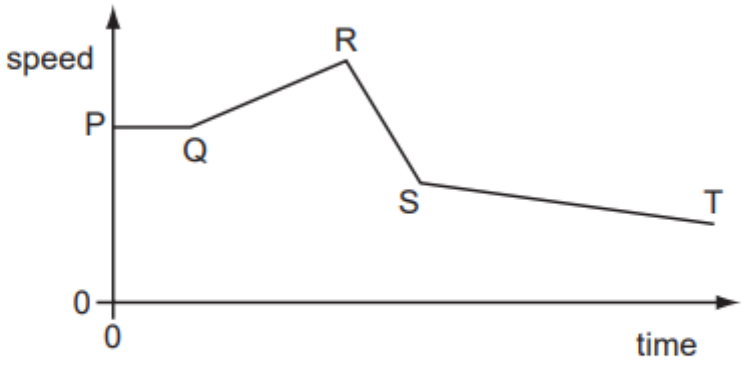
4 A tennis player hits a ball hard and 0.40 s later hears the echo from a wall.

The speed of sound in air is 330 m / s.

How far away is the player from the wall?

A 66 m **B** 132 m **C** 264 m **D** 825 m

5 The diagram shows the speed / time graph for a train as it travels along a track.

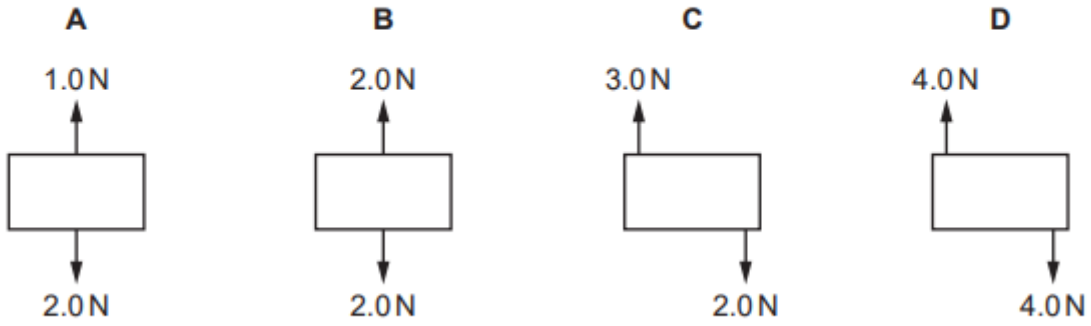


For which part of the graph is the train's speed changing at the greatest rate?

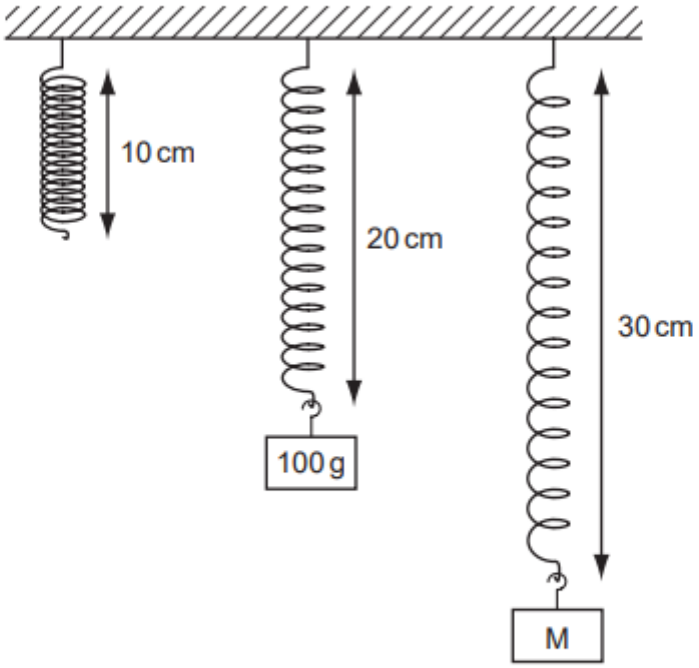
A PQ **B** QR **C** RS **D** ST

6 Four objects are each acted on by only two forces, as shown.

Which object is in equilibrium?



7 Objects with different masses are hung on a spring. The diagram shows how much the spring stretches.



The extension of the spring is directly proportional to the mass hung on it.

What is the mass of object M?

A 110 g **B** 150 g **C** 200 g **D** 300 g

8 Weight is an example of which quantity?

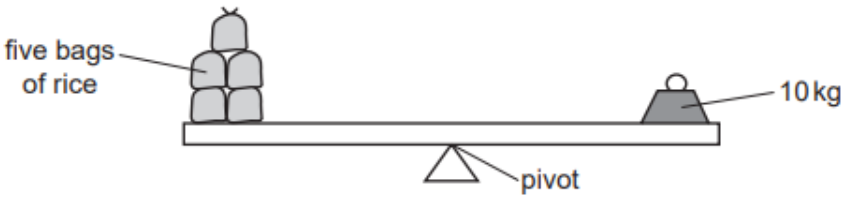
A acceleration

B force

C mass

D pressure

9 Five identical bags of rice are balanced on a uniform beam by an object of mass 10 kg.

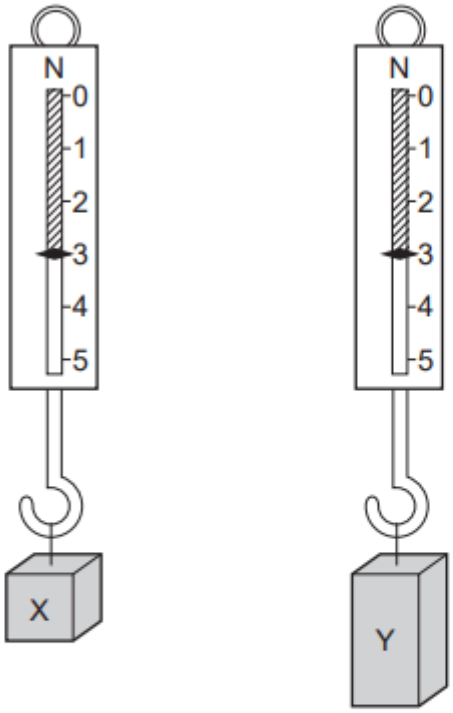


Two more identical bags of rice are added to the other five. The average position of the bags on the beam does not change.

What mass now balances the bags?

A 3.5 kg **B** 7.0 kg **C** 12 kg **D** 14 kg

10 Two blocks of metal X and Y hang from spring balances, as shown in the diagrams.



What does the diagram show about X and Y?

A They have the same mass and the same volume but different weights.

B They have the same mass and the same weight but different volumes.

C They have the same mass, the same volume and the same weight.

D They have the same weight and the same volume but different masses.

11 Which quantities are measured in the same unit?

A energy, power and work

B energy and power, but not work

C energy and work, but not power

D power and work, but not energy

12 A cyclist travels down a hill from rest at point X, without pedalling.

The cyclist applies his brakes and the cycle stops at point Y.

Which energy changes have taken place between X and Y?

A gravitational potential → kinetic → thermal (heat)

B gravitational potential → thermal (heat) → kinetic

C kinetic → gravitational potential → thermal (heat)

D kinetic → thermal (heat) → gravitational potential

13 Which movement will require the greatest amount of work to be done?

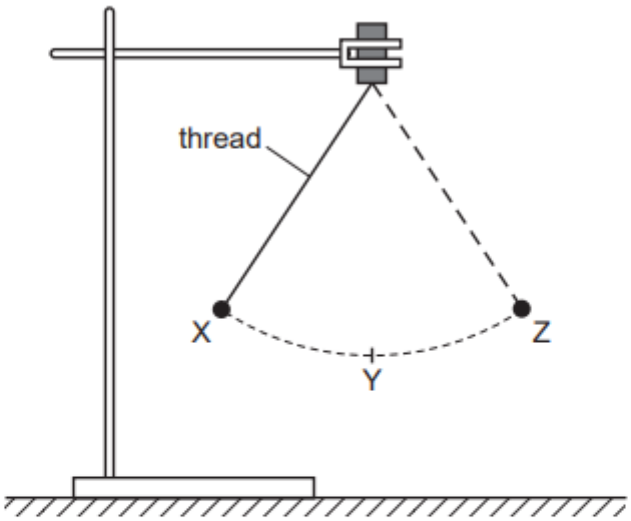
A a force of 10 N moving an object a distance of 3.0 m

B a force of 10 N moving an object a distance of 5.0 m

C a force of 15 N moving an object a distance of 3.0 m

D a force of 15 N moving an object a distance of 5.0 m

14 An object on a thread is swinging between X and Z, as shown in the diagram. It is momentarily at rest at X and at Z.



An incomplete word equation about the energy of the object is shown below.

gravitational potential energy at X = kinetic energy at Y + ... energy at Y + energy losses

Which form of energy is needed to complete the word equation?

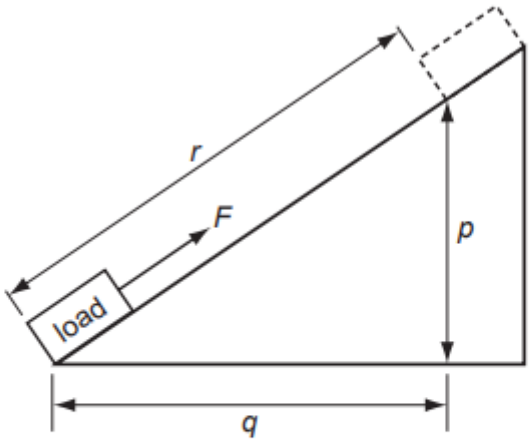
A chemical

B gravitational potential

C internal

D strain

15 A force *F* moves a load from the bottom of a slope to the top.



The work done by the force depends on the size of the force, and on a distance.

What is this distance?

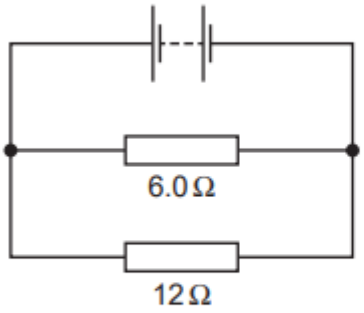
A *p** **B** *q** **C** *r** **D** *p* + *q*

16 P and Q are the circuit symbols for two electrical components.

Which components are represented by P and by Q?

	P	Q
A	thermistor	fuse
B	thermistor	relay
C	variable resistor	fuse
D	variable resistor	relay

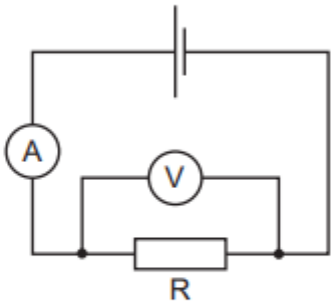
17 The diagram shows two resistors connected in a circuit.



What could be the combined resistance of this arrangement of resistors?

A 4.0Ω **B** 6.0Ω **C** 9.0Ω **D** 18Ω

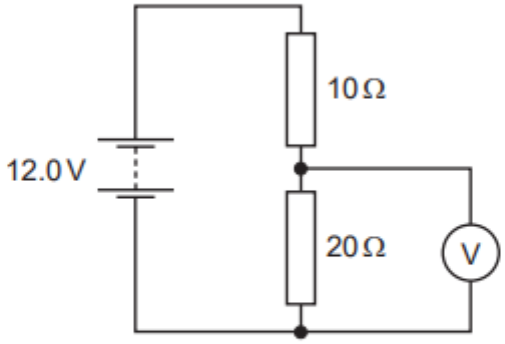
18 A circuit is set up to determine the resistance of a resistor R. The meter readings are 2.0A and 3.0V.



What is the resistance of the resistor R?

A 0.67Ω **B** 1.5Ω **C** 5.0Ω **D** 6.0Ω

19 The diagram shows a 10Ω resistor and a 20Ω resistor connected in a potential divider circuit.



What is the reading on the voltmeter?

A 4.0V **B** 6.0V **C** 8.0V **D** 12.0V

20 Which statement is **not** correct for lamps connected in parallel?

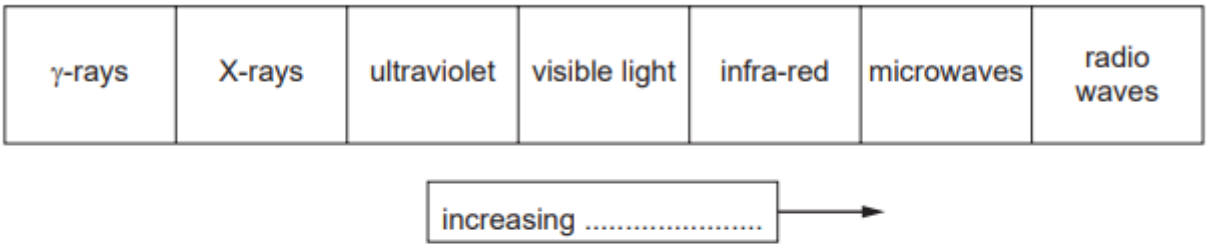
A They can be switched on and off separately.

B They will remain bright if another lamp is connected in parallel.

C They share the supply voltage equally between them.

D They still operate if one lamp is removed.

21 The diagram shows the electromagnetic spectrum.



A word is missing from the label below the spectrum.

Which word is missing?

A amplitude

B frequency

C speed

D wavelength

22 Infra-red waves, microwaves, radio waves and sound waves are all used for communications.

Which waves travel at the same high speed in a vacuum?

A infra-red waves, microwaves and radio waves

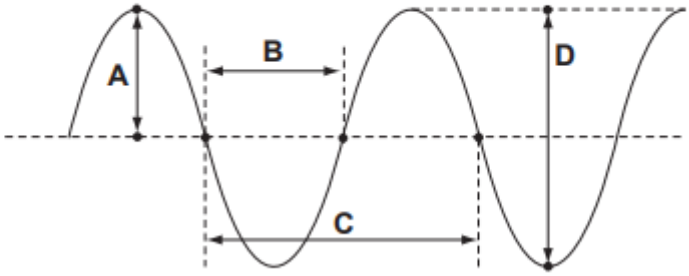
B infra-red waves, microwaves and sound waves

C infra-red waves, radio waves and sound waves

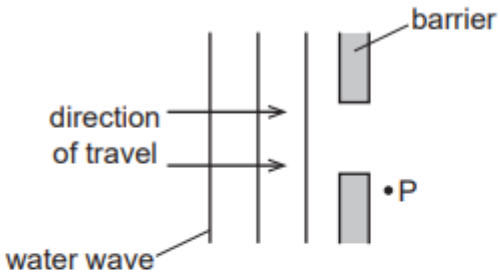
D microwaves, radio waves and sound waves

23 The diagram shows a wave.

Which labelled distance is the wavelength?



24 The diagram shows a water wave approaching a barrier with a gap.



The wave reaches point P.

What is the name of the effect that causes the wave to reach point P?

A diffraction

B dispersion

C reflection

D refraction

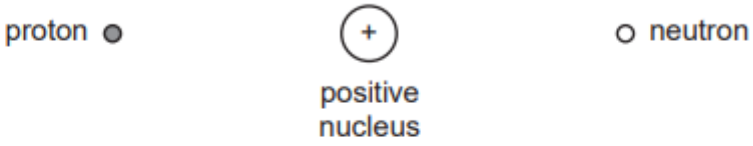
25 Which row correctly defines a type of wave and gives a correct example?

	wave type	direction of vibrations	example
A	longitudinal	parallel to direction of wave travel	radio waves
B	longitudinal	perpendicular to direction of wave travel	light waves
C	transverse	parallel to direction of wave travel	light waves
D	transverse	perpendicular to direction of wave travel	radio waves

26 How many neutrons are in a nucleus of the nuclide $^{37}_{17}Cl$?

A 17 **B** 20 **C** 37 **D** 54

27 A proton and a neutron are each close to a positive nucleus.



How does the charge on the nucleus affect the proton and the neutron, if at all?

A The neutron is attracted; the proton is repelled.

B The neutron is not affected; the proton is repelled.

C The proton is attracted; the neutron is repelled.

D The proton is not affected; the neutron is repelled.

28 A sample of a radioactive isotope has an initial rate of emission of 128 counts per minute and a half-life of 4 days.

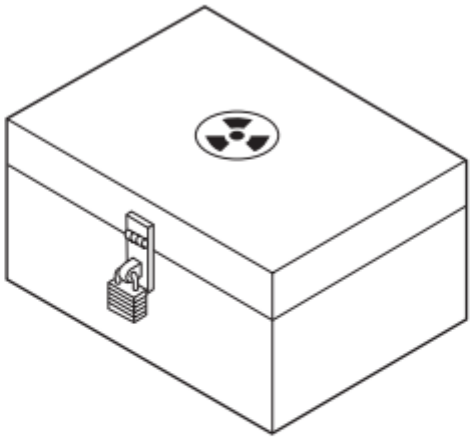
How long will it take for the rate of emission to fall to 32 counts per minute?

A 2 days **B** 4 days **C** 8 days **D** 12 days

29 Which row gives the properties of the radiation from radioactive materials?

	most penetrating radiation	most highly ionising radiation
A	α	β
B	β	γ
C	γ	α
D	γ	γ

30 The diagram shows a box used for storing radioactive sources.



Which material is best for lining the box to prevent the escape of most radioactive emissions?

A aluminium

B copper

C lead

D steel

Section B 20 marks. Attempt all questions.

1 The period of the vertical oscillations of a mass hanging from a spring is known to be constant.

(a) A student times single oscillations with a stopwatch. In 10 separate measurements, the stopwatch readings were:

1.8 s, 1.9 s, 1.7 s, 1.9 s, 1.8 s, 1.8 s, 1.9 s, 1.7 s, 1.8 s, 1.8 s.

What is the best value obtainable from these readings for the time of one oscillation? Explain how you arrive at your answer.

best value = ...

explanation .....

.....

..... [1]

(b) Describe how, using the same stopwatch, the student can find the period of oscillation more accurately.

.....

.....

.....

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.....

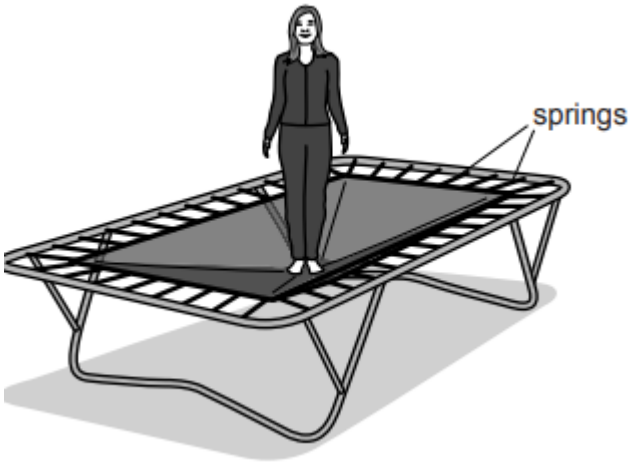
.....

..... [4]

Total for question = 5 marks

2 An athlete of mass 64 kg is bouncing up and down on a trampoline.

At one moment, the athlete is stationary on the stretched surface of the trampoline.
the athlete at this moment.



(a) State the form of energy stored due to the stretching of the surface of the trampoline.

.....[1]

(b) The stretched surface of the trampoline begins to contract. The athlete is pushed vertically upwards and she accelerates. At time t, when her upwards velocity is 6.0 m/s, she loses contact with the surface.

(i) Calculate her kinetic energy at time t.

kinetic energy = ...[2]

(ii) Calculate the maximum possible distance she can travel upwards after time t.

maximum distance = ...[3]

(iii) In practice, she travels upwards through a slightly smaller distance than the distance calculated in **(ii)**.

Suggest why this is so.

.....

.....[1]

(c) The trampoline springs are tested. An extension-load graph is plotted for one spring. Fig. 3.2 is the graph.

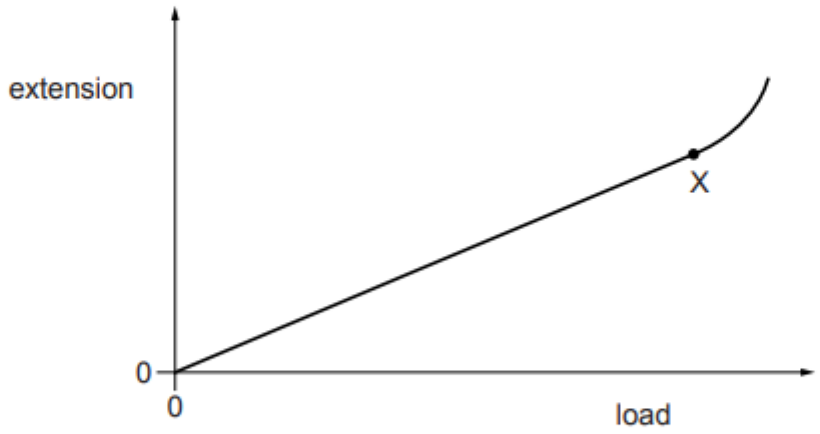


Fig. 3.2

(i) State the name of the point X.

.....[1]

(ii) State the name of the law that the spring obeys between the origin of the graph and point X.

.....[1]

Total for question = 9 marks

3 **(a)** Two students are measuring the speed of sound.

The students are provided with a starting pistol, a stopwatch and a long measuring tape. The starting pistol, when fired, produces a loud sound and a puff of smoke at the same instant.

Describe how the students use the apparatus and how they calculate the speed. You may draw a diagram.

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..... [4]

(b) A device at the bottom of the sea emits a sound wave of frequency 200 Hz.

The speed of sound in sea-water is 1500 m / s.

Calculate the wavelength of the sound in sea-water.

wavelength = ... [2]

Total for question = 6 marks

End of questions