



TEMASEK JUNIOR COLLEGE

2016 Preliminary Examination
Higher 1

PHYSICS

8866/01

Paper 1 Multiple Choice

20 September 2016

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, Civics group and Index Number on the Answer Sheet in the spaces provided.

There are **thirty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
acceleration of free fall,	$g = 9.81 \text{ m s}^{-2}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
hydrostatic pressure,	$p = \rho gh$
resistors in series,	$R = R_1 + R_2 + \dots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \dots$

- 1 The behaviour of many real gases can be represented by an equation of the form

$$\left(p + \frac{a}{V_m^2}\right) (V_m - b) = RT$$

where p is pressure, V_m is volume per mole, T is temperature, R is a constant, and the values of a and b are characteristics of the particular gas.

What are the units of a and b ?

	a	b
A	$\text{Pa m}^{-6} \text{ mol}^2$	$\text{m}^3 \text{ mol}$
B	$\text{Pa m}^6 \text{ mol}^{-2}$	$\text{m}^3 \text{ mol}$
C	$\text{Pa m}^{-6} \text{ mol}^2$	$\text{m}^3 \text{ mol}^{-1}$
D	$\text{Pa m}^6 \text{ mol}^{-2}$	$\text{m}^3 \text{ mol}^{-1}$

- 2 A plastic ruler is used to measure the thickness of a block whose thickness is 7.5 cm. Repeated measurements give the following readings.

Thickness/ cm	7.6	7.5	7.8	7.4	7.6
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Which of the following is correct?

	results are accurate to within 0.1 cm	results are precise to within 0.1 cm
A	Yes	No
B	Yes	Yes
C	No	Yes
D	No	No

- 3 Which of the following statements is correct?

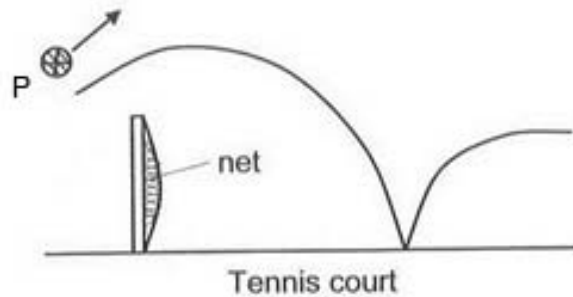
- A** In the measurement of the diameter of a sphere, take more readings and finding the average value of these readings will help to reduce the fractional uncertainty of the diameter.
- B** Plotting a graph of voltage and current readings for an ohmic conductor and using its gradient to find resistance will help to eliminate random error.
- C** Measuring the timing of a larger number of oscillations will help to reduce the fractional uncertainty of the period.
- D** Checking for zero error on a voltmeter before measuring voltage will help to reduce random error.

- 4 The acceleration of free fall, g , can be determined using the equation for the period T of a simple pendulum of length L given by

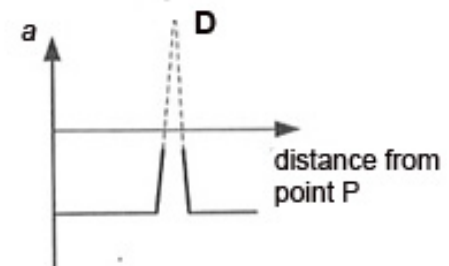
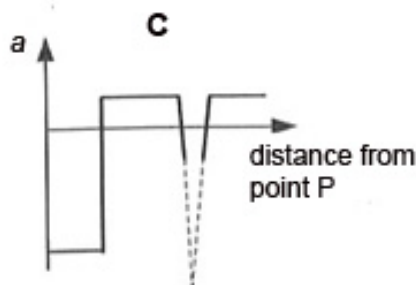
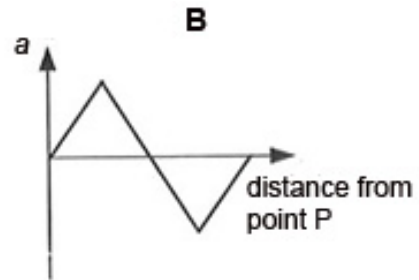
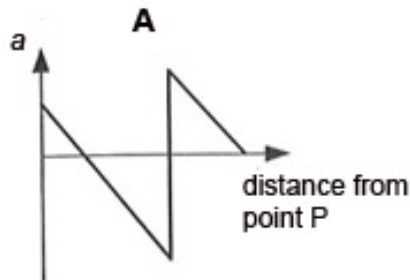
$$T = 2\pi \sqrt{\frac{L}{g}}$$

If the length of the pendulum is measured to be $L = (0.500 \pm 0.001)$ m, and the period is measured to be $T = (1.42 \pm 0.02)$ s, what should the student record as the value of g ?

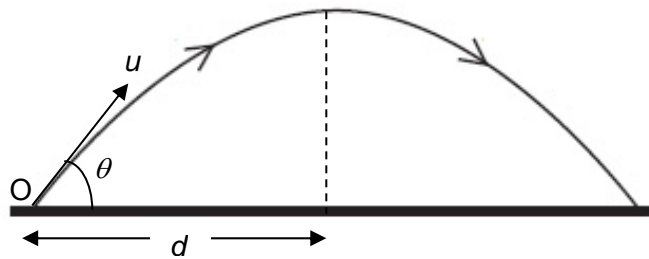
- A $(9.8 \pm 0.3) \text{ m s}^{-2}$
 B $(9.79 \pm 0.03) \text{ m s}^{-2}$
 C $(9.79 \pm 0.30) \text{ m s}^{-2}$
 D $(9.789 \pm 0.295) \text{ m s}^{-2}$
- 5 The figure below shows the trajectory of a tennis ball crossing the net and bouncing once from the ground.



Which of the following graphs represents the variation with the horizontal distance from point P of the acceleration a of the ball, taking the upward direction as positive?



- 6 A body is thrown vertically upwards in a medium in which the viscous drag cannot be neglected. If the times of flight for the upward motion t_u and the downward motion t_d to return to the same level are compared, then
- A $t_d > t_u$, because the body moves faster on its downward flight and therefore the viscous force is greater.
 - B $t_d > t_u$, because at a given speed the net accelerating force when the body is moving downwards is smaller than the retarding force when it is moving upwards.
 - C $t_d < t_u$, because the effect of the viscous force is the greatest at the moment of projection.
 - D $t_d = t_u$, because the effect of the viscous force is the same whether the body is moving upwards or downwards.
- 7 Ball X of mass m is projected with a speed of u at point O at an angle of θ above the ground. It reaches its maximum height when its horizontal displacement is d .

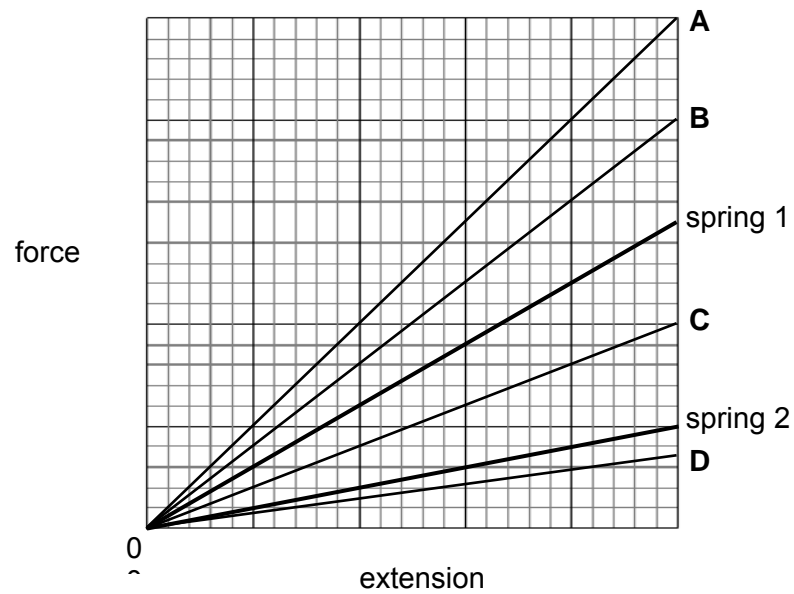


Another ball Y of mass $2m$ is projected with a speed of $2u$ from O at the same angle θ above the horizontal.

What is the horizontal displacement of ball Y when it reaches its maximum height?
Ignore air resistance.

- A d
- B between d and $2d$
- C $2d$
- D further than $2d$

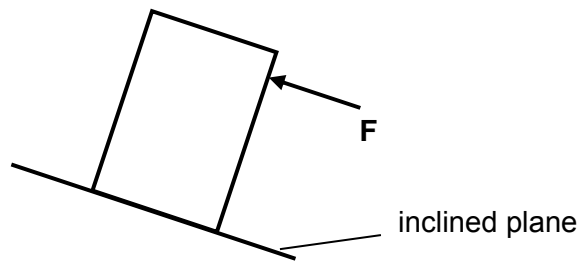
- 8 Two springs of equal unstretched lengths but different spring constants are subjected to a variable force. The force-extension graphs of both springs are shown in the following diagram.



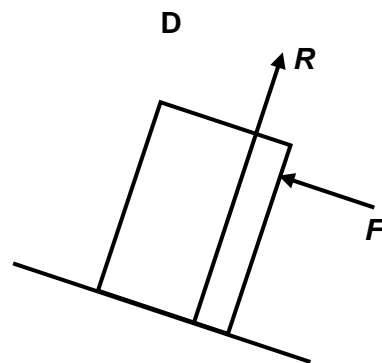
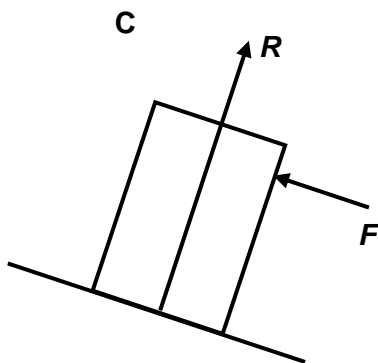
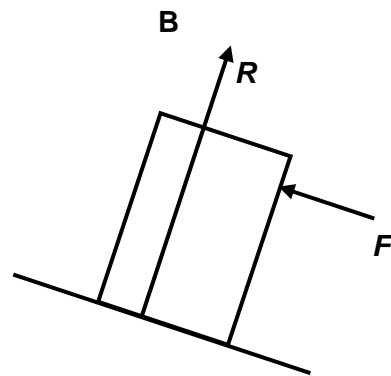
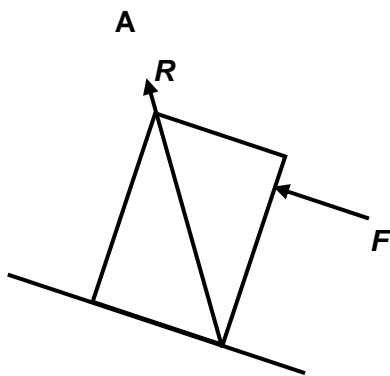
The springs are then joined in parallel and subjected to the same variable force.

Which of the other lines in the grid would represent the new force-extension graph of the two springs joined in parallel?

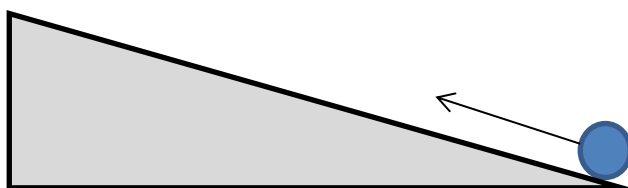
- 9 A uniform block rests on a smooth inclined plane, supported by a force F to prevent it from moving.



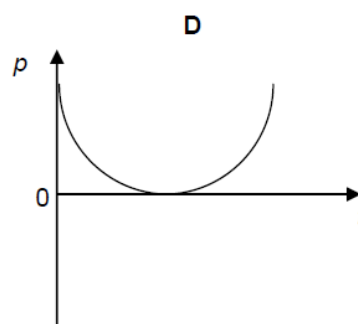
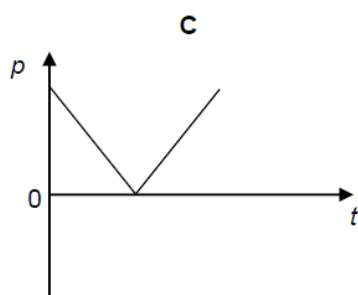
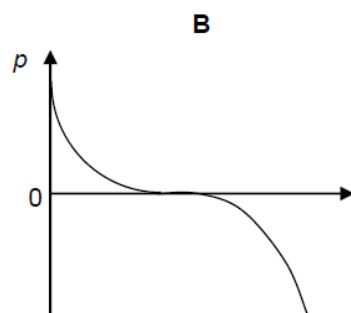
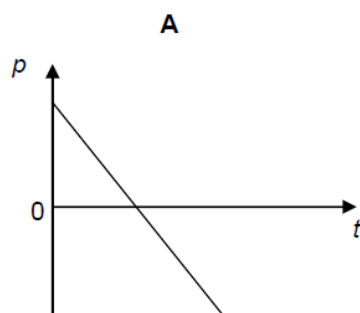
Which of the following diagrams correctly shows the force R exerted by the inclined plane on the block?



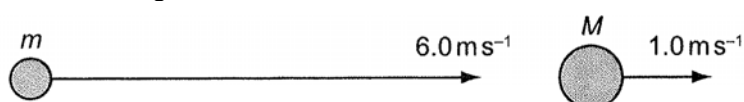
- 10 An object is projected up a long smooth inclined plane as shown in the diagram.



Which graph best shows the variation of the momentum p of the object along the slope with time t ?



- 11 A ball of smaller mass m travelling at 6.0 m s^{-1} collides elastically with a ball of larger mass M travelling at 1.0 m s^{-1} .



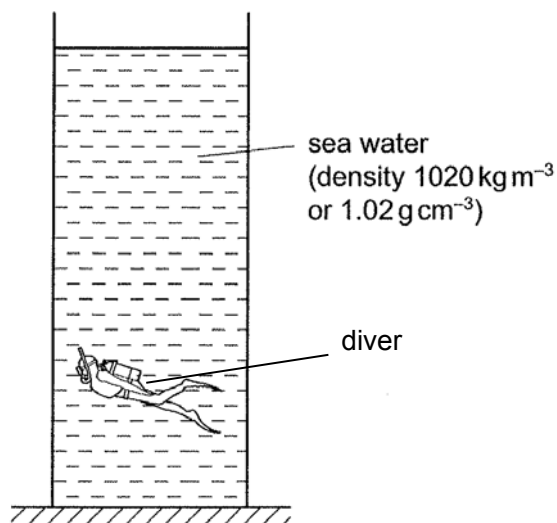
Which diagram represents the velocities of the two balls after the collision?

- A**
-
- B**
-
- C**
-
- D**
-

- 12 Two balls X and Y are dropped from a very tall building. Both balls reach terminal velocity before hitting the ground. The balls have the same diameter. The mass of X is greater than the mass of Y.

Which statement is correct?

- A The balls hit the ground at the same time.
 - B The terminal velocity of Y is greater than that of X.
 - C The initial acceleration of both balls is the same.
 - D The balls have the same kinetic energy just before hitting the ground.
- 13 The diagram shows a tall water-filled tower used for training divers.

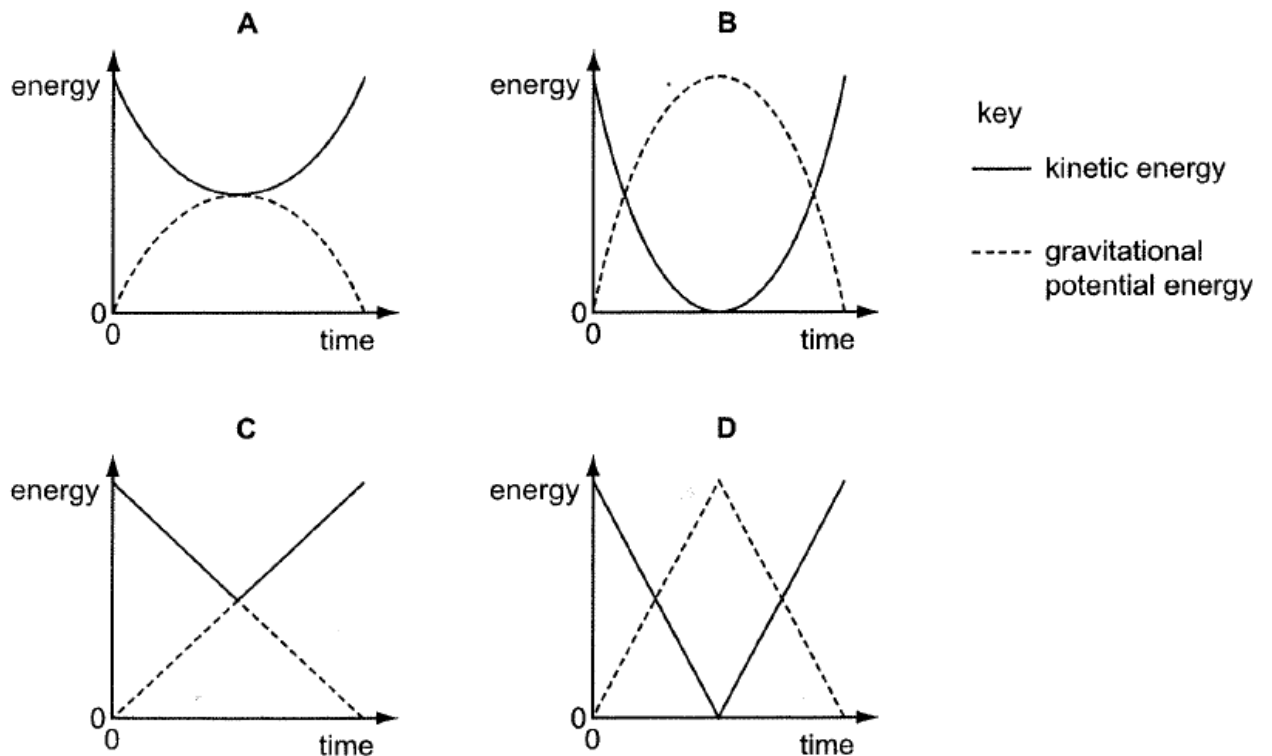


Which of the following gives the rate of change of pressure with depth in this tower?

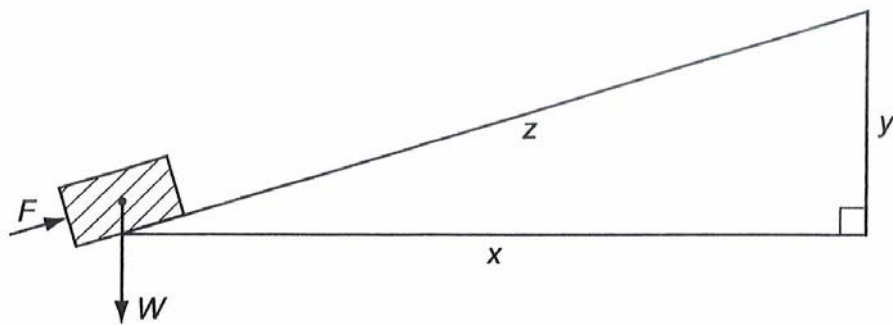
- A 1.0 Pa m⁻¹
- B 10 Pa m⁻¹
- C 1.0 x 10³ Pa m⁻¹
- D 1.0 x 10⁴ Pa m⁻¹

- 14 A soccer player hits a ball so that it leaves the ground at an angle of 45° to the horizontal.

Which graph represents the variation of kinetic energy and of gravitational potential energy with time of the ball during the time of flight? Assume that air resistance can be ignored.



- 15 A block of weight W rests on a rough slope of dimensions, x , y and z as shown.



A force F pushes the block all the way up the slope. The block starts and finishes at rest.

How much work is done by the force F ?

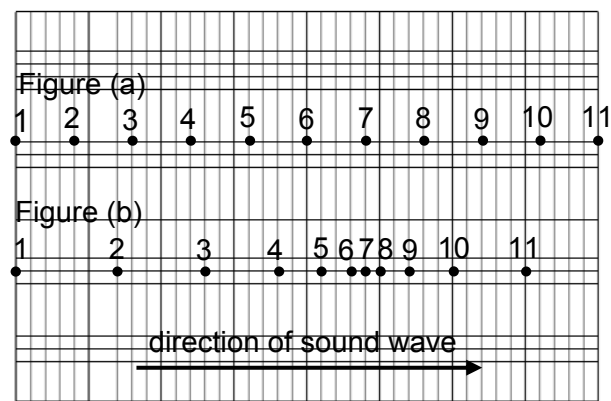
- A Wy B $Wy + Fz$ C Wz D Fz

16 Which expression may be used to calculate power?

- A charge x potential difference
- B force x distance moved in the direction of the force
- C velocity x force in the direction of the velocity
- D work done x time taken

17 Figure (a) shows the positions of equally spaced molecules in a solid lattice.

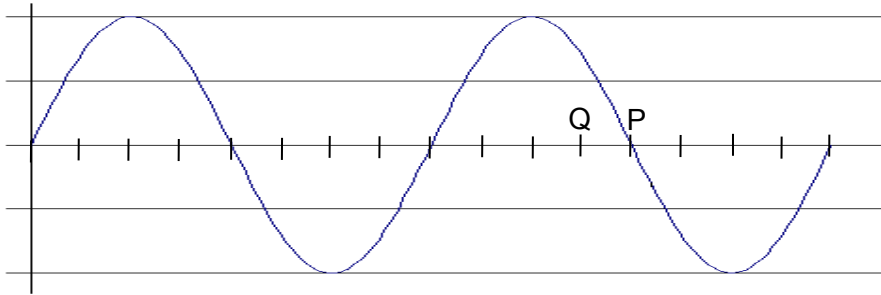
A longitudinal sound wave travels from left to right through the solid. At a certain instant, the displaced positions of the molecules are shown in Figure (b).



Immediately afterwards, what will be the directions of motion of particles 1 and 7?

	particle 1	particle 7
A	to the right	to the right
B	to the right	to the left
C	to the left	to the right
D	to the left	to the left

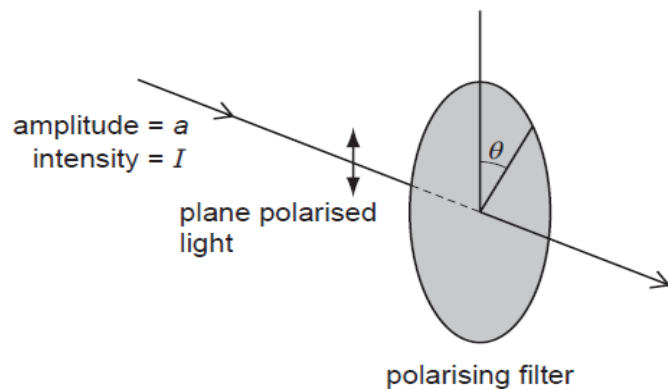
- 18 The diagram shows the profile of a transverse wave at a particular instant. The wave is travelling to the right. The frequency of the wave is 12.5 Hz.



At the instant shown the displacement is zero at the point P.

What is the shortest time to elapse before the displacement is zero at point Q?

- A** 0.01 s **B** 0.02 s **C** 0.03 s **D** 0.07 s
- 19 The figure below shows a plane-polarised light of intensity I and amplitude a passing through a polarising filter.

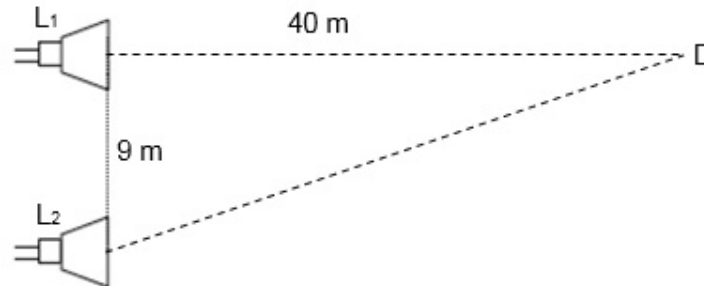


If the plane of polarization θ to the vertical as shown in the diagram is 60° , what is the intensity of the emergent light?

- A** $0.25I$ **B** $0.50I$ **C** $0.75I$ **D** $0.87I$

- 20 Two loudspeakers L_1 and L_2 , placed 9 m apart, are driven by a common oscillator as shown in the diagram.

As the frequency of the oscillator increases from zero, the detector at D, placed 40 m from L_1 , recorded a series of maximum and minimum signals.



If the speed of sound is 330 m s^{-1} , at what frequency is the first maximum observed?

- A 165 Hz B 330 Hz C 495 Hz D 660 Hz
- 21 A standing wave is established in air in a pipe with one closed and one open end.



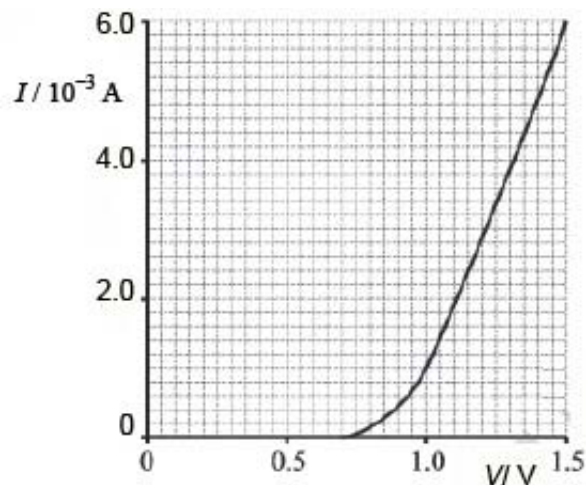
Which of the following correctly describes the air molecules near X?

- A always at the centre of a compression.
 B always at the centre of a rarefaction.
 C alternately at the centre of a compression and at the centre of a rarefaction.
 D never at the centre of a compression or a rarefaction.
- 22 A filament lamp is described as being “120 V, 60 W”. The lamp is connected to a supply so that it lights normally.

Which statement is correct?

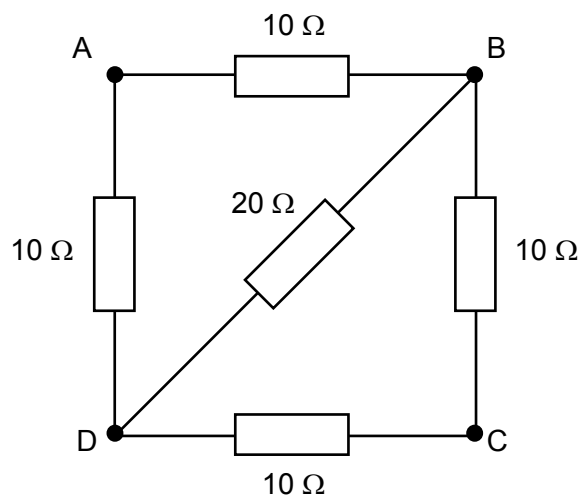
- A The charge passing through the filament in one second is 2.0 C.
 B The lamp transfers 60 J for 1.0 C of charge passing through the filament.
 C The lamp transfers 120 J in 2.0 s.
 D The supply provides 60 J to the lamp when the current is 2.0 A.

- 23 The graph shows the I - V characteristic of a semiconductor diode.



Which statement about the resistance of the diode can be deduced from the graph?

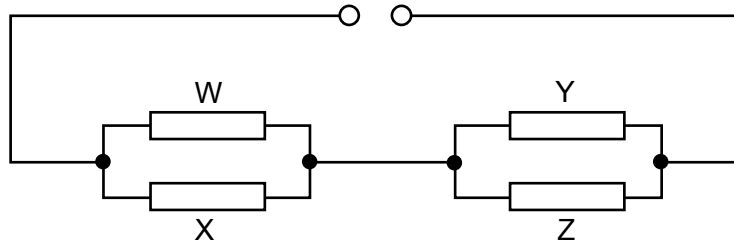
- A It is zero between 0 V and 0.70 V.
 - B It is constant between 1.0 V and 1.5 V.
 - C It is 0.4Ω at 1.2 V.
 - D It decreases between 0.70 V and 1.0 V.
- 24 In the circuit shown, four identical resistors of resistance 10Ω are connected in a square with a 20Ω resistor connected across the diagonal. A fixed p.d. is connected across BD.



How will the power to the circuit change if the same p.d. is connected across AB instead?

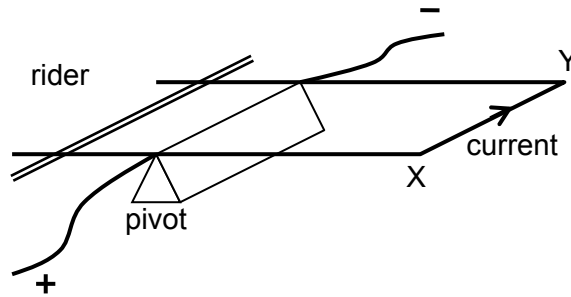
- A The power will remain the same.
- B The power will decrease.
- C The power will increase.
- D Not enough information to determine how the power will change.

- 25 Four identical resistors W, X, Y and Z are connected as shown.

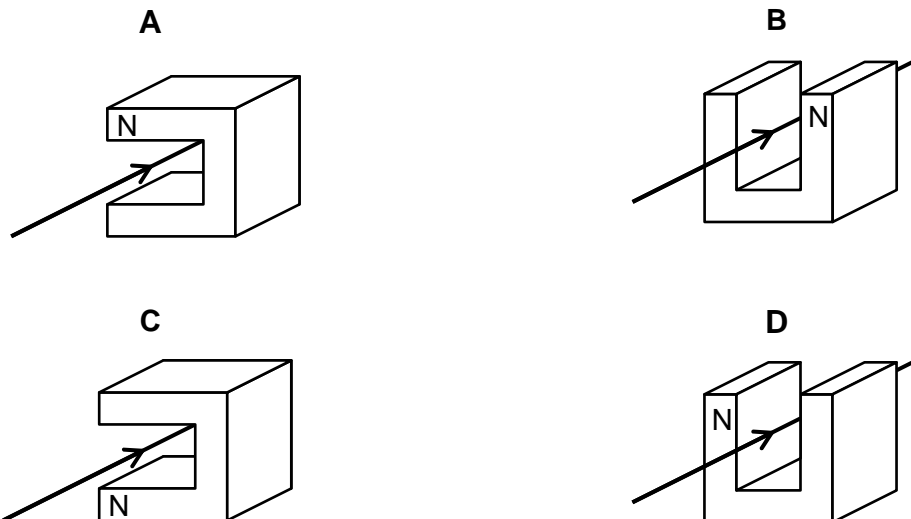


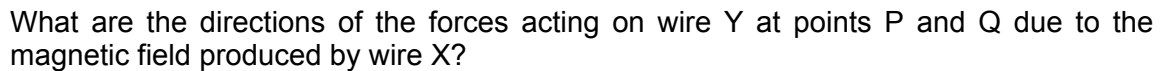
How will the current through the resistors change when resistor W is removed?

- A The current through X will increase and the currents through Y and Z will decrease.
 B The current through X will decrease and the currents through Y and Z will increase.
 C The current through X will increase and the currents through Y and Z will remain unaltered.
 D The currents through X, Y and Z will all decrease.
- 26 The diagram below shows a current balance used to determine the strength of a magnet.



Which of the following shows the correct placement of the magnet relative to XY?





28 Light of frequency f incident on a given metal surface produces photoelectrons with a maximum kinetic energy K .

A 0 **B** less than $2K$ **C** $2K$ **D** more than $2K$

- Which one of the following equations correctly relates f_1 , f_2 and f_3 ?

30 An electron of mass m travelling with speed u collides with an atom and its speed is reduced to v . The speed of the atom is unaltered, but one of its electrons is excited to a higher energy level and then returns to its original state, emitting a photon.

A $\frac{m(u^2 - v^2)}{2h}$ **B** $\frac{m(v^2 - u^2)}{h}$ **C** $\frac{m(u^2 + v^2)}{2h}$ **D** $\frac{mv^2}{2h}$