NAME: _____ **HT GROUP:** _____

CATHOLIC JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATIONS, 2009

PHYSICS **8866 / 1**
Higher 1

30 marks

Friday
18 Sep 2009
1 hour

Instructions

Candidates will answer on the Optical Mark Sheet only.

Data

Speed of light in free space	$c = 3.00 \times 10^{8}$ m s^{-1}
Elementary charge	$e = 1.60 \times 10^{-19}$ C
The Planck constant	$h = 6.63 \times 10^{-34}$ Js
Unified atomic mass constant	$u = 1.66 \times 10^{-27}$ kg
Rest mass of electron	$m_e = 9.11 \times 10^{-31}$ kg
Rest mass of proton	$m_p = 1.67 \times 10^{-27}$ kg
Acceleration of free fall	g = 9.81 m s^{-1}

Formula

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	$R = R_1 + R_2 + \ldots$
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

1 Uncertainties in measurement may be either systematic or random.

Which of the following involves random uncertainty?

A Not allowing for zero uncertainty on a voltmeter
B Not substracting background count rate when determining the count rate from a radioactive source
C Stopping a stopwatch at the end of a race
D Using the value g = 10 N kg^{-1} when calculating weight from mass

2 What are the meanings of the prefixes pico (p) and giga (G) ?

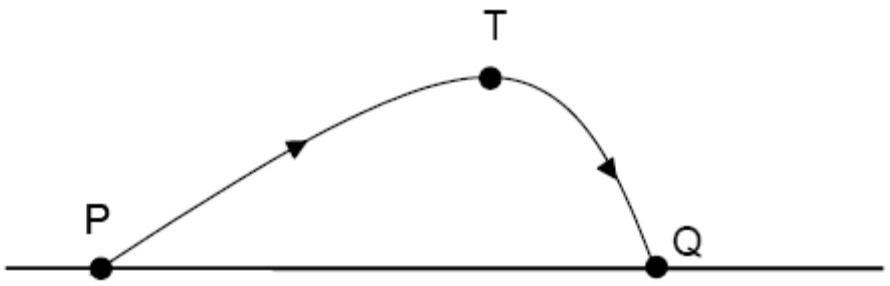
	Pico (p)	Giga (G)
A	x 10^{-9}	x 10^{9}
B	x 10^{-9}	x 10^{12}
C	x 10^{-12}	x 10^{9}
D	x 10^{-12}	x 10^{12}

3 An Olympic athlete competes in a sprint race.

What is the best estimate of his mean kinetic energy during the race?

A 4 x 10^{2} J **B** 4 x 10^{3} J **C** 4 x 10^{4} J **D** 4 x 10^{5} J

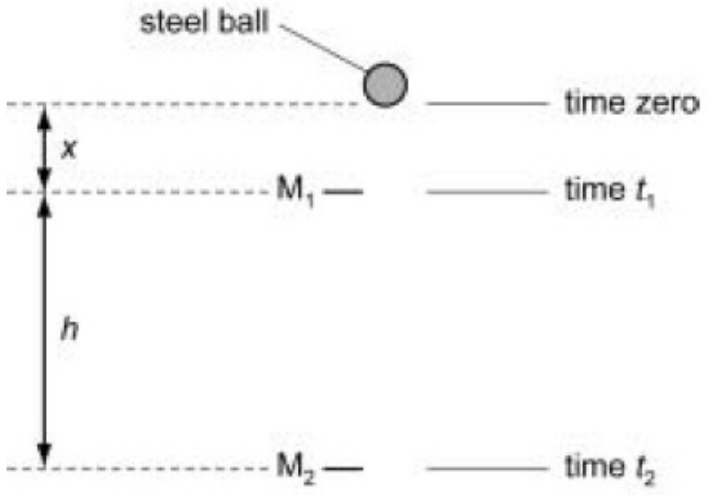
4 In the presence of air resistance, a stone is thrown from P and follows a path in which the highest point reached is T as shown in the diagram below.



Given that the drag force acting on the stone is directly proportional to the magnitude of its instantaneous velocity, the vertical component of the acceleration of the stone is

A Highest at point P
B Zero at point T
C Constant through the traveled path
D The same at point P and point Q

5 Two markers M_1 and M_2 are set up a vertical distance h apart.

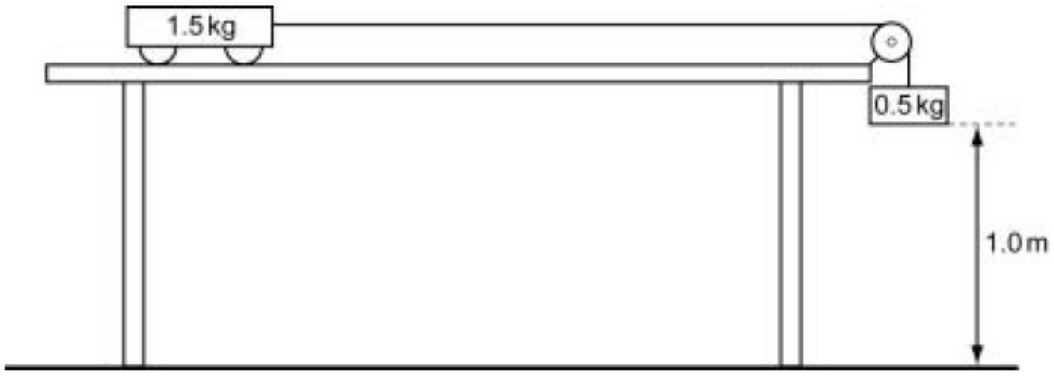


A steel ball is released at time zero from a point distance x above M_1. The ball reaches M_1 at time t_1 and reaches M_2 at time t_2. The acceleration of the ball is constant.

Which expression gives the acceleration of the ball?

A $\frac{2h}{t_2^{\,2}}$ **B** $\frac{2h}{(t_2 + t_1)}$ **C** $\frac{2h}{(t_2 - t_1)^2}$ **D** $\frac{2h}{(t_2^{\,2} - t_1^{\,2})}$

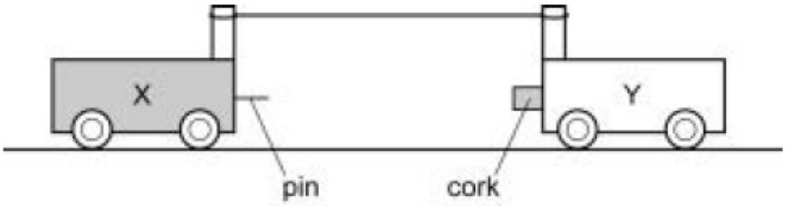
6 The diagram shows a trolley being pulled from rest along a horizontal table by a falling mass. The trolley mass is 1.5 kg and the falling mass falls through 1.0 m.



What is the maximum kinetic energy of the trolley?

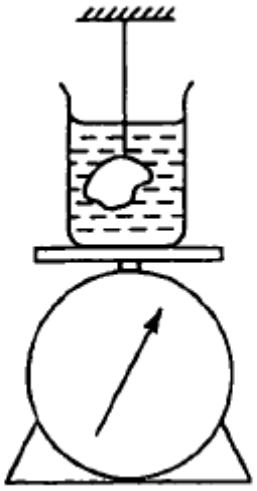
A 3.7 J **B** 4.9 J **C** 15 J **D** 20 J

7 The diagram shows two trolleys X and Y held stationary and connected by an extended elastic cord. The mass of X is twice that of Y.



The trolleys are released at the same instant. They move towards each other and stick together on impact. Just before the collision, the speed of X is 20 cm s^{-1}.
What is the speed of Y just after the collision?

A Zero
B 5 cm s^{-1}.
C 7 cm s^{-1}.
D 10 cm s^{-1}.

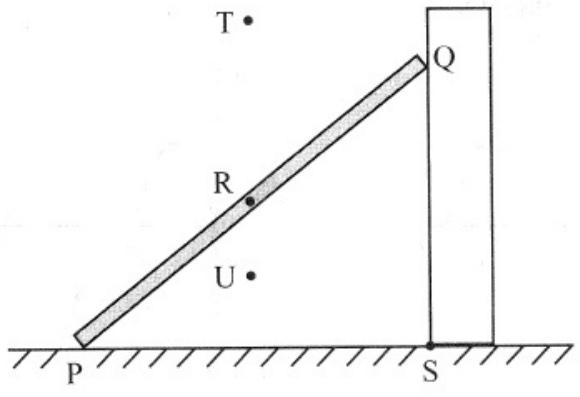


8 When a beaker of water rests on a balance, the weight indicated is X. A solid object of weight Y in air displaces weight Z of water when immersed.

What will be the balance reading when the object is suspended in the beaker of water so that it is totally immersed as shown in the figure?

A X
B X + Z
C X + Y
D X + Y – Z

9 The diagram below shows a ladder PQ with a center of mass R resting on a rough wall QS.



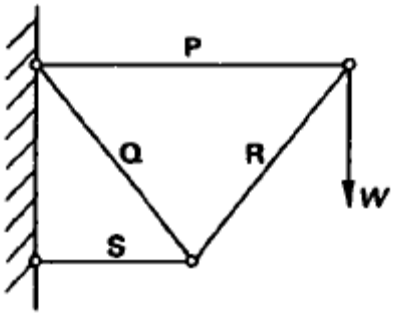
The resultant forces at P and Q are F_P and F_Q respectively. If the ladder is in equilibrium, F_P and F_Q must act through point

A R
B S
C T
D U

10 Which of the statements below describes a rigid body in equilibrium ?

A The algebraic sum of the moments of force about any axis needs not be zero.
B The algebraic sum of the moments of force about any axis is zero, and the resultant force in any direction needs not be zero.
C The algebraic sum of the moments of force about any axis is zero, and the resultant force in any direction is zero.
D The algebraic sum of the moments of force about any axis passing through the center of mass is zero, and the resultant force the center of mass is zero.

11 In order to support a load W, four light hinged rods P, Q, R and S are connected as shown below and mounted in a vertical plane.



Which rods are in compression and which in tension?

	In compression	In tension
A	P, Q	R, S
B	Q, R	P, S
C	Q, R, S	P
D	R, S	P, Q

12 Which of the following is a correct definition of the moment of a force?

A Mass x velocity
B Force x distance in the direction of the force
C Force x distance perpendicular to the force
D Force x time in which the force acts

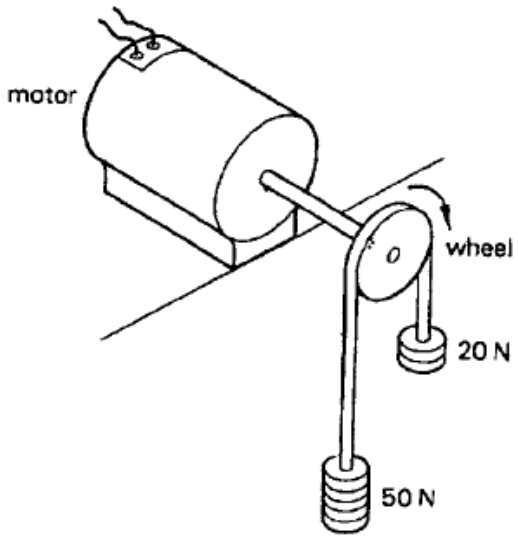
13 An aircraft moving through air at velocity v experiences a resistive force F given by the expression $F = k v^2$. Where k is a constant.

What is the power required to keep the aircraft moving at this constant velocity ?

A $k v$
B $k v^2$
C $k v^3$
D $k v^4$

14 Which of the following statements is a good explanation of why car tires become hot after travelling a distance without stepping on the brakes?

A Heat is generated through the friction between the tires and the road
B Heat is generated through the compression and decompression of the tires
C Heat is generated from the air resistance against the car
D Heat is generated from the friction between the tires and the car brakes

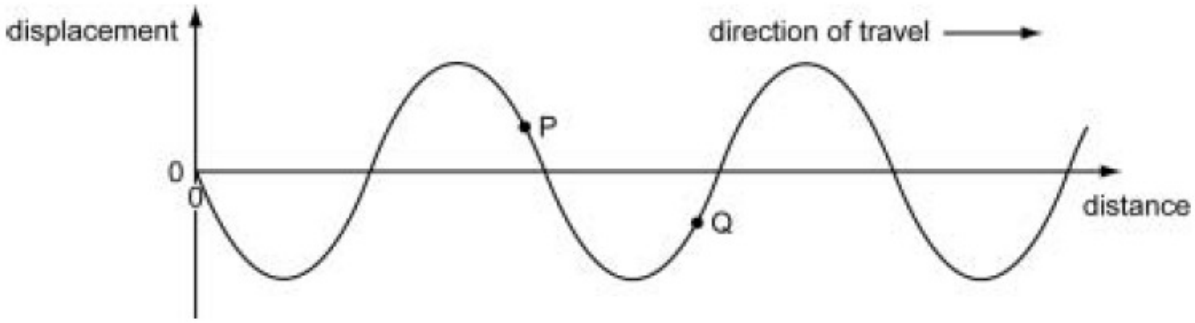


15 The figure shows an arrangement used to find the output power of an electric motor. The wheel attached to the motor's axle has a circumference of 0.5 m and the belt which passes over it is stationary when the weights have the values shown.

If the wheel makes 20 revolutions per second, what is the output power?

A 200 W
B 300 W
C 500 W
D 600 W

16 A transverse progressive wave travels along a rope. The graph shows the variation of displacement with distance along the rope at a certain time. The wave is travelling to the right.



In which direction are the points P and Q on the rope moving?

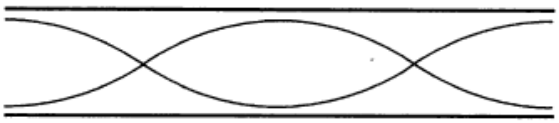
	Movement of P	Movement of Q
A	Downwards	Downwards
B	Downwards	Upwards
C	Upwards	Downwards
D	Upwards	Upwards

17 A sound wave is emitted from a point source. The intensity of a sound wave is inversely proportional to the square of the distance from the source. At a distance r from the source the amplitude of the wave is 8X.

What is the amplitude at a distance 2r from the source?

A 8X **B** 4X **C** 2X **D** X

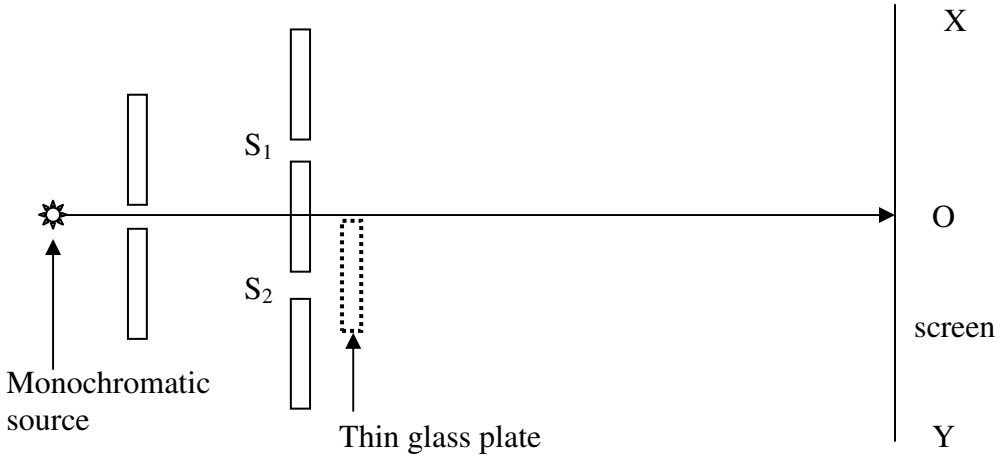
18 A stationary wave is formed in the air in an open tube as represented in the diagram.



How many antinodes are formed by a stationary wave of twice the frequency?

A 2 **B** 4 **C** 5 **D** 6

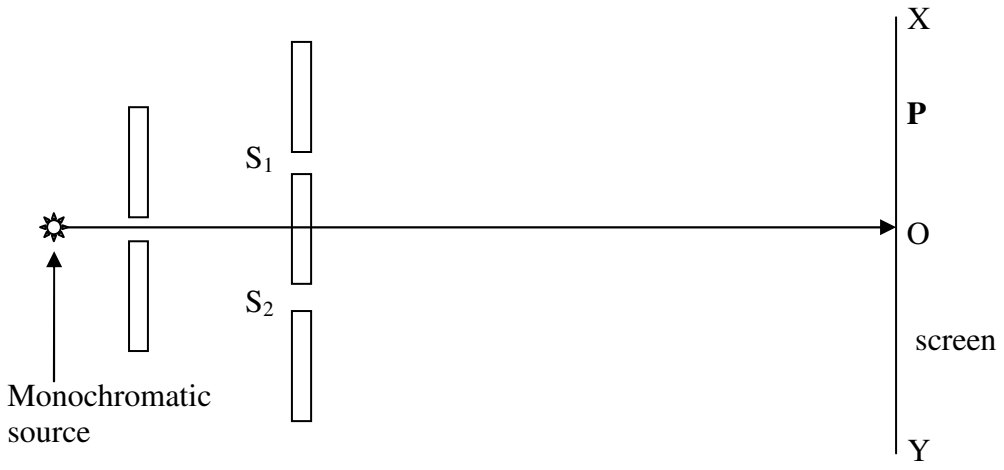
19 The diagram below illustrates an experimental arrangement that produces interference fringes with a double slit.



When slit S_2 was covered with a very thin plate of glass as shown,

A The separation of the fringes increased
B The separation of the fringes decreased
C The fringe pattern moved towards X
D The fringe pattern moved towards Y

20 Coherent light is incident on the two fine parallel slits, S_1 and S_2, as shown in the diagram.



If a dark fring occurs at P, which of the following gives possible phase differences for the light waves arriving at P from S_1 and S_2 ?

A $2\pi, 4\pi, 6\pi \ldots$

B $\pi, 3\pi, 5\pi \ldots$

C $\pi, 2\pi, 3\pi \ldots$

D $\frac{1}{2}\pi, {}^{3}/_{2}\pi, {}^{5}/_{2}\pi \ldots$

21 A battery, during its usable lifetime, supplies a constant current of 40 μA to a clock for 800 days. How much charge does the battery supply during this time?

A 20 μC **B** 32 000 μC **C** 46 C **D** 2800 C

22 A generator produces 100 kW of power at a p.d. of 10 kV. The power transmitted through cables of total resistance 5Ω. What is the power loss in the cables?

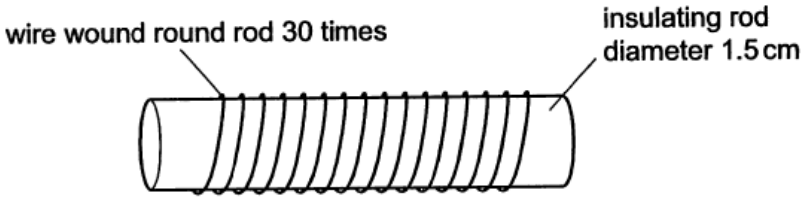
A 50 W

B 250 W

C 500 W

D 1000 W

23 The material of a wire has resistivity 1.3×10^{-8} Ωm. The wire has diameter 0.50 mm and its length is just enough to enable it to be wound tightly round an insulating rod 30 times. The rod has diameter 1.5 cm.

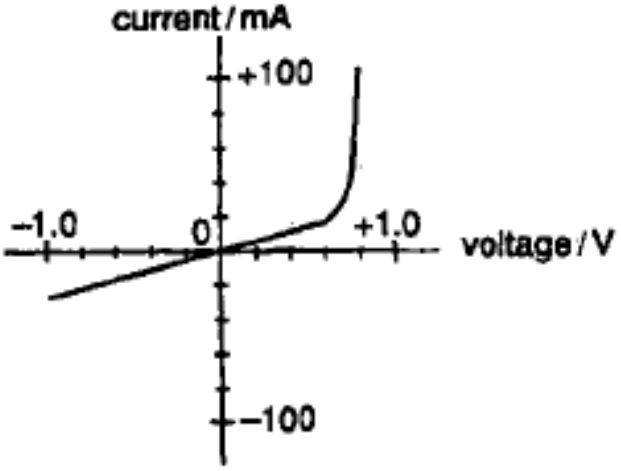


What is the resistance of the wire?

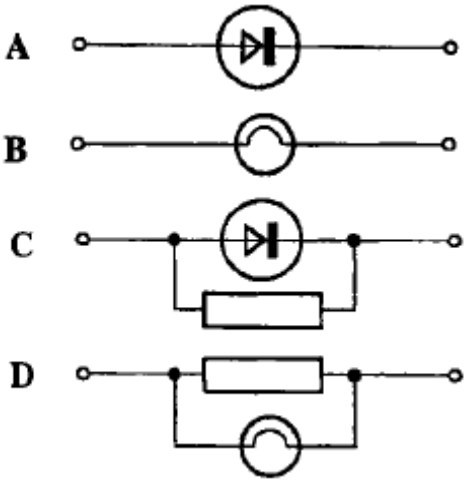
A 1.1×10^{1} Ω **B** 9.4×10^{-2} Ω **C** 7.0×10^{-4} Ω **D** 1.1×10^{-5} Ω

24 A student is given a sealed box containing a concealed electrical circuit.

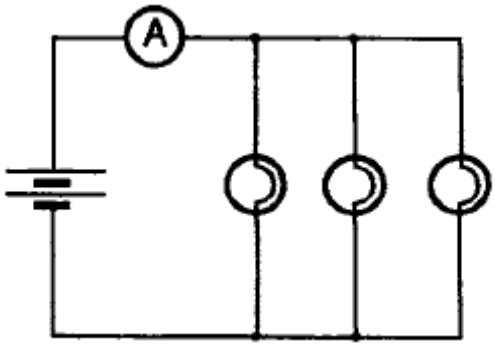
Having taken a series of current and voltage readings, the student plots the current-voltage characteristic below.



Which circuit is most likely to be enclosed within the box?



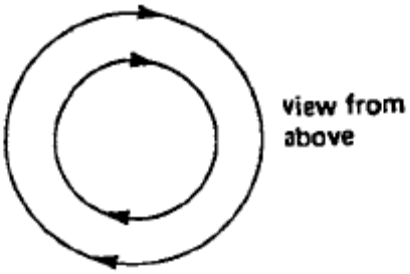
25 Three similar light bulbs are connected to a constant-voltage d.c. supply as shown in the diagram. Each bulb operates at normal brightness and the ammeter (of negligible resistance) registers a steady current.



The filament of one of the bulbs breaks. What happens to the ammeter reading and to the brightness of the remaining bulbs?

	Ammeter reading	Bulb brightness
A	Increases	Increases
B	Increases	Unchanged
C	Unchanged	Unchanged
D	Decreases	Unchanged

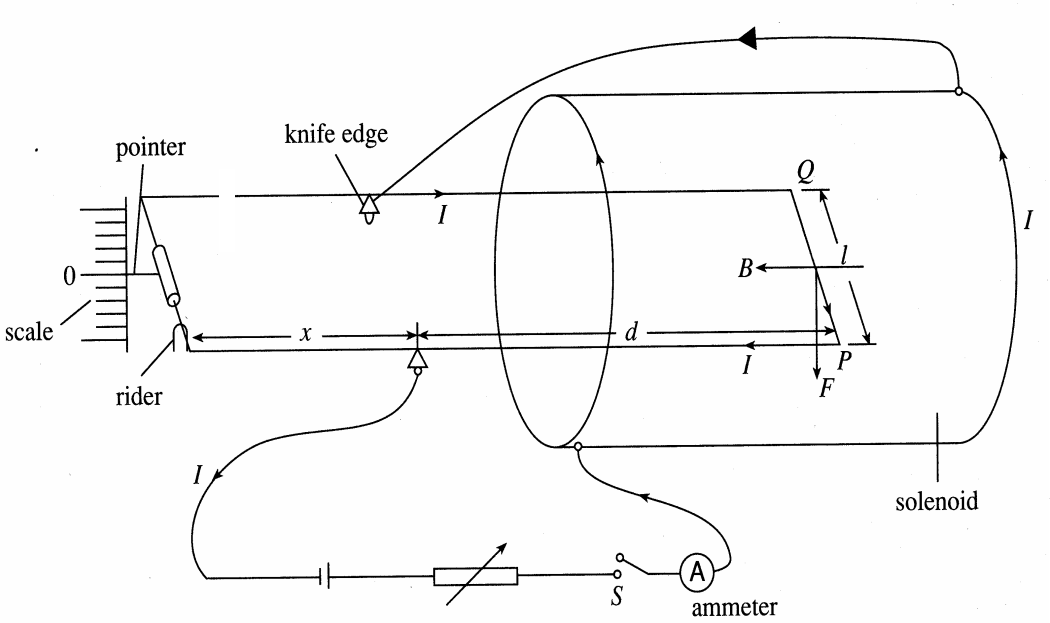
26 A small coil lies inside a larget coil. The two coils are horizontal, concentric and carry current in the same direction.



The small coil will experience

A A torque about a horizontal axis
B A torque about a vertical axis
C An upward force along the axis
D No resultant force

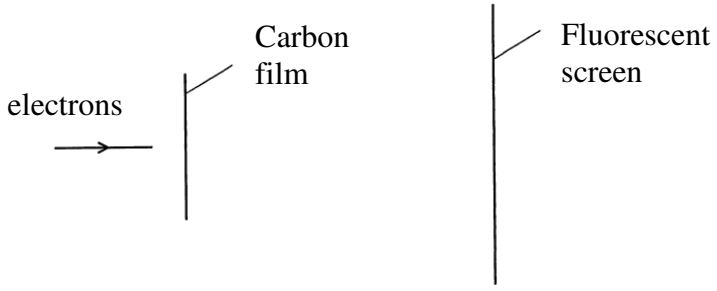
27. A current balance device as shown in the figure below was set up to determine the magnetic field strength created by a solenoid. The first experiment determined the magnetic field strength as *B*. The setup was used again with one or some of the factors changed. A larger mass of the rider had to be used in the second experiment.



Which one of the following could most likely be the changes made?

A The knife edge was moved closer to PQ.
B The current passing through the solenoid and the number of turns of the solenoid are reduced.
C The first experiment was set up such that the direction of the Earth's magnetic field is opposite to the magnetic field created by the coil while the second experiment had both magnetic fields in the same direction.
D Another frame with a shorter length for PQ was used.

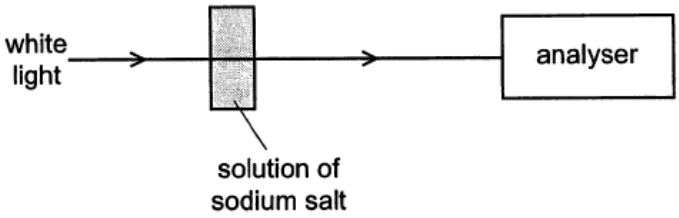
28 Electrons with velocity v travel through a vacuum and are incident on a thin carbon film, as shown in the figure below.

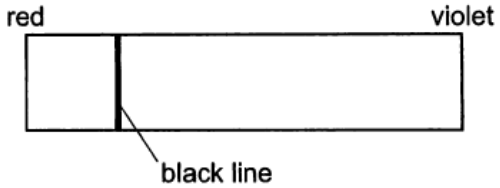


The electrons produce a pattern of concentric circles on the fluorescent screen.
What causes the pattern and which change to the pattern occurs when the velocity v is increased?

	Cause	Change to pattern
A	Diffraction	Diameters of circles increase
B	Diffraction	Diameters of circles decrease
C	Refraction	Diameters of circles increase
D	Refraction	Diameters of circles decrease

29 White light is passed through a solution containing a sodium salt. The light which emerges is analysed to form a spectrum.

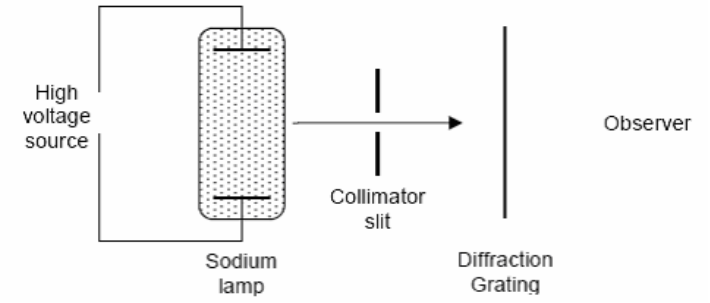


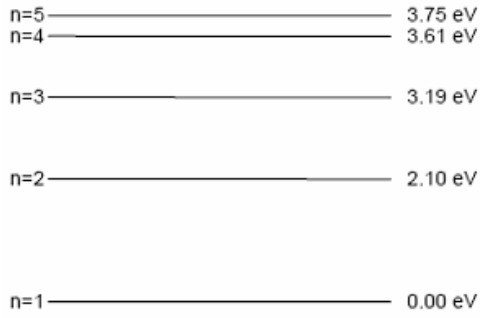


The spectrum consists of a continuous band of colour from red to violet, with a black line in the yellow region.
Why is the black line produced in this spectrum?

A **Electrons** of a particular energy are **absorbed** by the sodium salt.
B **Electrons** of a particular energy are **emitted** by the sodium salt.
C **Photons** of a particular energy are **absorbed** by the sodium salt.
D **Photons** of a particular energy are **emitted** by the sodium salt.

30 A spectrometer is set up to observe the spectrum produced by the sodium lamp as shown in the figure to the left. The energy levels of the lowest states of sodium are given in the right figure below.





How many spectra lines of unique wavelengths corresponding to these energy levels can be observed?

A 4 **B** 9 **C** 10 **D** 20

THE END