

NATIONAL JUNIOR COLLEGE
Preliminary Examination
Higher 1

CANDIDATE
NAME

SUBJECT
CLASS

REGISTRATION
NUMBER

PHYSICS

8866/01

Paper 1 Multiple Choice

18 September 2015

Additional Materials: Multiple Choice Answer Sheet

1 hour

READ THE INSTRUCTION FIRST

Write in soft pencil.

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

Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on 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.

This document contains 13 printed pages, including this cover page.

Data

speed of light in free space,
 permeability of free space,
 permittivity of free space,
 elementary charge,
 the Planck constant,
 unified atomic mass constant,
 rest mass of electron,
 rest mass of proton,
 molar gas constant,
 the Avogadro constant,
 the Boltzmann constant,
 gravitational constant,
 acceleration of free fall,

Formulae

uniformly accelerated motion,
 work done on/by a gas,
 hydrostatic pressure
 gravitational potential,
 displacement of particle in s.h.m.,
 velocity of particle in s.h.m.,
 mean kinetic energy of a molecule of an ideal gas
 resistors in series,
 resistors in parallel,
 electric potential,
 alternating current/voltage,
 Transmission coefficient
 radioactive decay,

$$\begin{aligned}
 c &= 3.00 \times 10^8 \text{ ms}^{-1} \\
 \mu_0 &= 4\pi \times 10^{-7} \text{ Hm}^{-1} \\
 \epsilon_0 &= 8.85 \times 10^{-12} \text{ Fm}^{-1} = (1/(36\pi)) \times 10^{-9} \text{ F m}^{-1} \\
 e &= 1.60 \times 10^{-19} \text{ C} \\
 h &= 6.63 \times 10^{-34} \text{ Js} \\
 u &= 1.66 \times 10^{-27} \text{ kg} \\
 m_e &= 9.11 \times 10^{-31} \text{ kg} \\
 m_p &= 1.67 \times 10^{-27} \text{ kg} \\
 R &= 8.31 \text{ JK}^{-1}\text{mol}^{-1} \\
 N_A &= 6.02 \times 10^{23} \text{ mol}^{-1} \\
 k &= 1.38 \times 10^{-23} \text{ JK}^{-1} \\
 G &= 6.67 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2} \\
 g &= 9.81 \text{ ms}^{-2}
 \end{aligned}$$

$$s = ut + \frac{1}{2}at^2, \quad v^2 = u^2 + 2as$$

$$W = p\Delta V$$

$$p = \rho gh$$

$$\phi = -\frac{Gm}{r}$$

$$x = x_0 \sin \omega t$$

$$v = v_0 \cos \omega t \text{ and } v = \pm \omega \sqrt{x_0^2 - x^2}$$

$$E = \frac{3}{2}kT$$

$$R = R_1 + R_2 + \dots$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

$$V = \frac{Q}{4\pi\epsilon_0 r}$$

$$x = x_0 \sin \omega t$$

$$T = \exp(-2kd) \text{ Where } k = \sqrt{\frac{8\pi^2m(U-E)}{h^2}}$$

$$x = x_0 \exp(-\lambda t)$$

decay constant,

$$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$$

1. The speed v of a liquid leaving a tube depends on the change in pressure ΔP and the density ρ the liquid. The speed is given by the equation

$$v = k \left(\frac{\Delta P}{\rho} \right)^n$$

where k is a constant that has no units.

What is the value of n ?

- A** 0.5 **B** 1 **C** 1.5 **D** 2

2. The young modulus of the material of a wire is to be found. The young modulus E is given by the equation below.

$$E = \frac{4Fl}{\pi d^2 x}$$

The wire is extended by a known force and the following measurements are made. Which measurement has the largest effect on the uncertainty in the value of the calculated Young modulus?

	Measurement	symbol	value
A	length of wire before force applied	l	2.043 ± 0.002 m
B	diameter of wire	d	0.54 ± 0.02 mm
C	force applied	F	19.62 ± 0.01 N
D	extension of wire with force applied	x	5.2 ± 0.2 mm

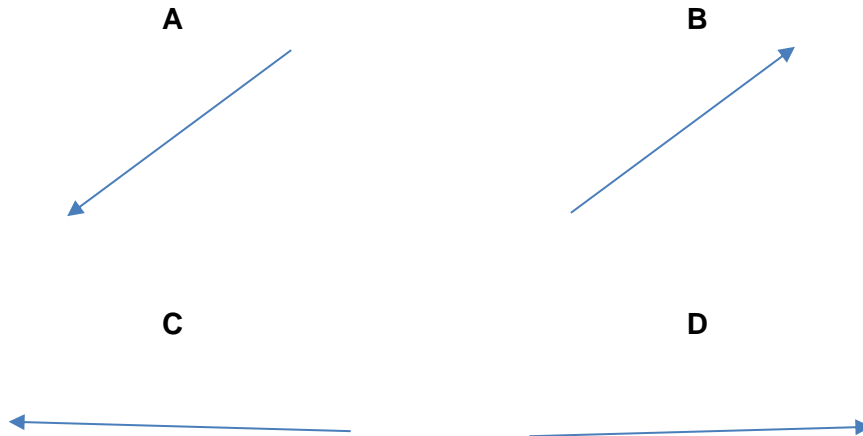
3. Which pair of physical quantities has the same base units?

- A** force and impulse
B moment of a force and momentum
C density and pressure
D rate of work done and power

4. Two displacements of an object are represented by the vectors **Q** and **R**.

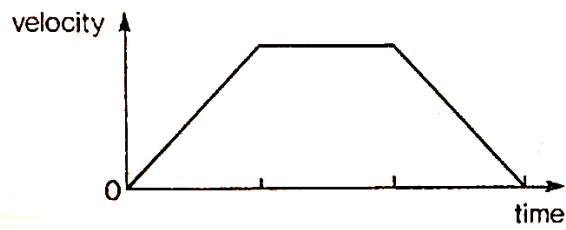


Which vector best represents the displacement $R - Q$?

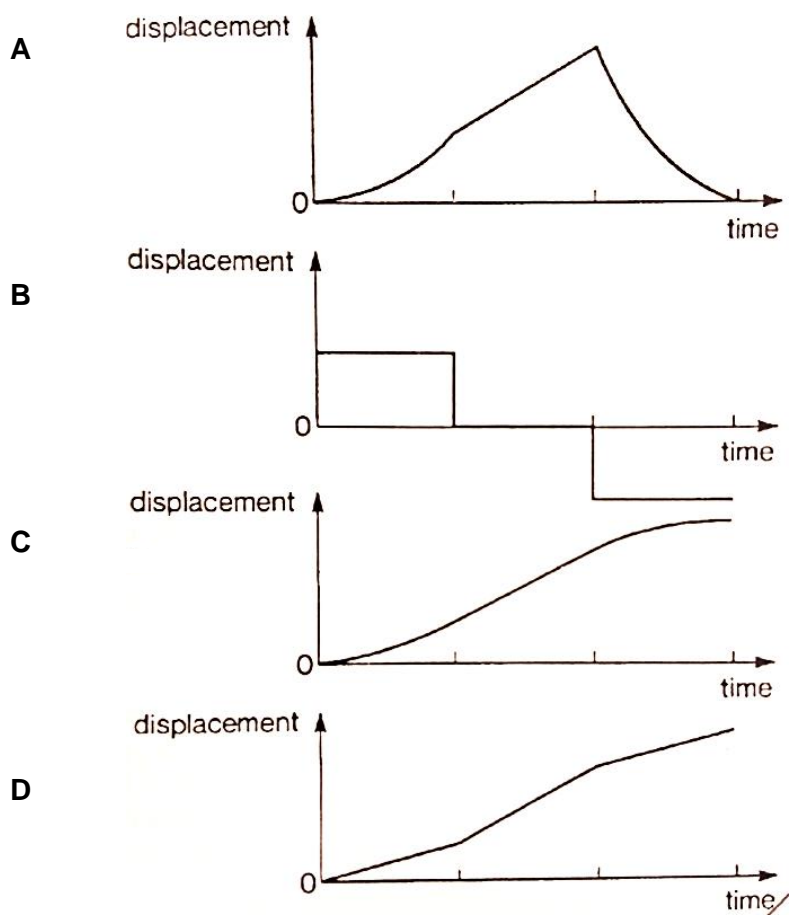


5. A stone is thrown from **P** and follows a parabolic path. The highest point reached is **T**. Neglecting air resistance, the acceleration of the stone
- A** is zero at **T**.
 - B** is greatest at **P**.
 - C** is greatest at **T**.
 - D** is the same at **P** as at **T**.
6. A cannon projects a cannonball in a parabolic path. Air resistance cannot be neglected. Which statement is correct?
- A** The resultant force on the cannonball acts downwards
 - B** The horizontal component of the cannonball's velocity is constant
 - C** The acceleration of the cannonball is higher than 9.81 ms^{-2}
 - D** The acceleration of the cannonball is lower than 9.81 ms^{-2}

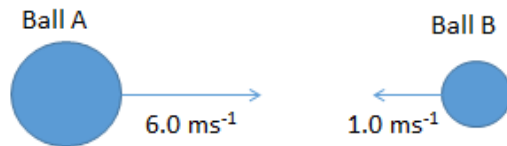
7. The graph of velocity against time for a car is shown below.



Which is the corresponding graph of displacement against time?



8. Ball **A** travelling at a speed of 6.0 ms^{-1} collides elastically with Ball **B** travelling at a speed of 1.0 ms^{-1}



Ball **A** has a larger mass than Ball **B**. Which are the velocities of the two balls after the collision?

	Ball A 's velocity	Ball B 's velocity
A	1.0 ms^{-1} , to the right	6.0 ms^{-1} , to the right
B	1.0 ms^{-1} , to the left	6.0 ms^{-1} , to the right
C	1.3 ms^{-1} , to the right	8.3 ms^{-1} , to the right
D	1.3 ms^{-1} , to the left	8.3 ms^{-1} , to the right

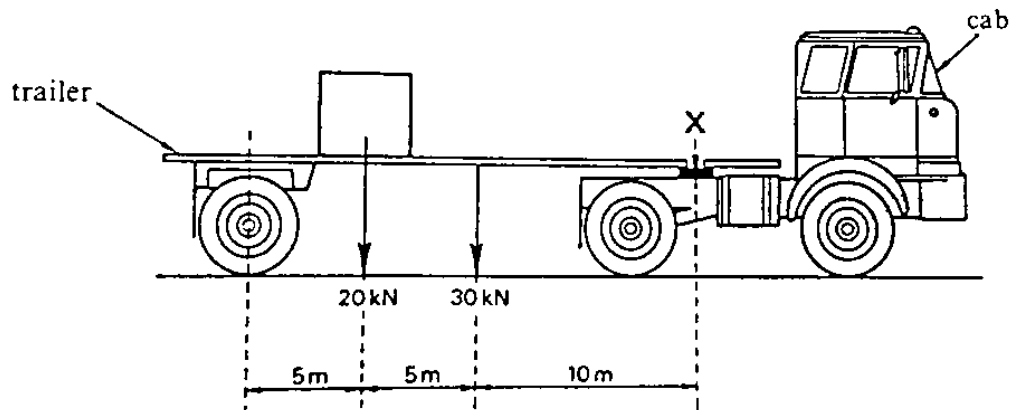
9. A stationary asteroid deep in space explodes into three different fragments. Which of these quantities is conserved?

- A** Kinetic energy and momentum are both conserved
- B** Kinetic energy is conserved but momentum is not conserved
- C** Kinetic energy is not conserved but momentum is conserved
- D** Neither kinetic energy nor momentum is conserved

10. Which of the following correctly describes an action-reaction pair?

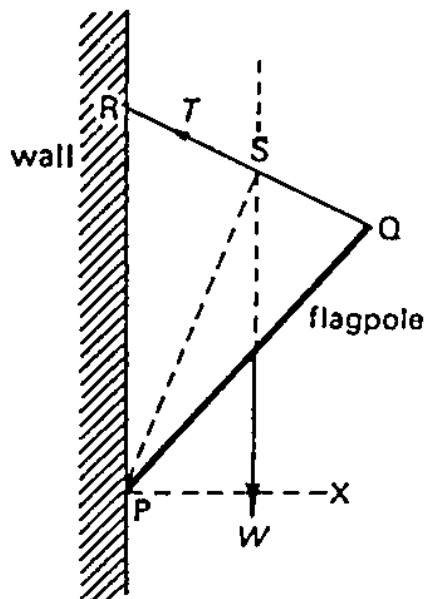
- A** The weight of a book and the normal contact force acting on it.
- B** The force by the rocket's thrusters and the gravitational force acting on the rocket.
- C** The gravitational force exerted by a man on the earth and his weight.
- D** The force by air resistance on a parachute and the weight of the parachutist.

11. What is the upward force by the cab on the trailer at Point X?



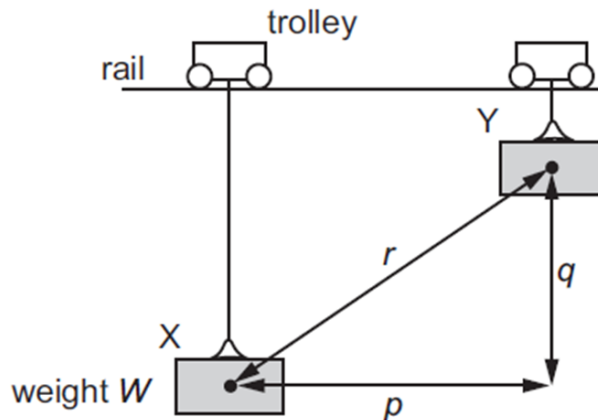
- A 15 kN B 20 kN C 30 kN D 40 kN

12. What is the direction of the force exerted by the wall on the flagpole?



- A From P to Q
B From P to S
C From P to X
D From Q to P

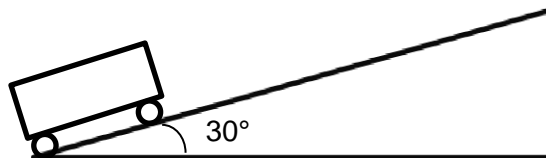
13. A block of weight W hangs from a trolley that runs along a rail. The trolley moves horizontally through a distance p and simultaneously raises the block through a height q .



As a result, the block moves through a distance r from X to Y . It starts and finishes at rest.

How much work is done on the block during this process?

- A Wp B $W(p+q)$ C Wq D Wr
14. For a toy car of mass 500 g to overcome the frictional forces on a rough floor moving at a constant speed 0.10 m s^{-1} , it develops an output power of 1.0 W. The resistive forces are constant at all speeds. Calculate the total output power developed by the car as it moves up the same rough slope shown below with the constant speed 0.20 m s^{-1} .



- A 2.0 W B 2.5 W C 2.8 W D 3.0 W
15. The least distance between two points of a progressive transverse wave which have a phase difference of $\frac{\pi}{3}$ rad is 0.200 m. If the frequency of the wave is 400 Hz, what is the speed of the wave?
- A 100 m s^{-1} B 180 m s^{-1} C 480 m s^{-1} D 720 m s^{-1}

16. A small source of sound radiates energy equally in all directions. The intensity of the sound 3.0 m away from the source is 0.18 Wm^{-2} . If the power of the source is tripled, the intensity at a distance 4.5 m away from the source is

A 0.090 Wm^{-2} **B** 0.14 Wm^{-2} **C** 0.18 Wm^{-2} **D** 0.24 Wm^{-2}

17. A student observes interference fringes produced by red light of wavelength 700 nm using a Young's double-slit arrangement. The slits are 1.0 m away from the screen.

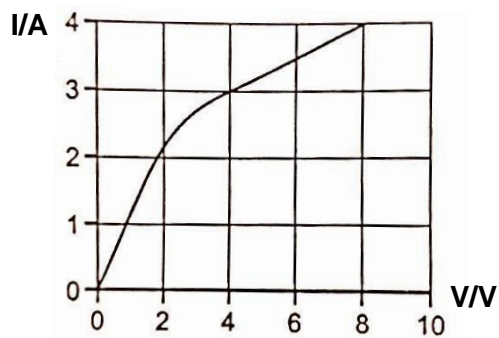
How should the student move the slits such that fringes of the same separation can be observed when using blue light of wavelength 400 nm?

- A** Move the slits 0.75 m towards the screen.
B Move the slits 0.75 m away from the screen.
C Move the slits 0.43 m towards the screen.
D Move the slits 0.43 m away from the screen.

18. Which pair of sources is coherent?

- A** Two identical light bulbs
B Two singers, each emitting a note of identical frequency
C A red laser and a blue laser
D Two ripple tank dippers in antiphase, oscillating at the same frequency

19. What is the resistance when the potential difference is 6.0 V?

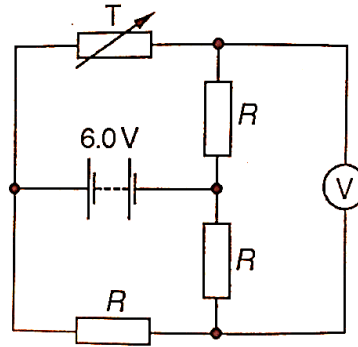


- A** 0.50Ω **B** 0.58Ω **C** 1.71Ω **D** 2.00Ω

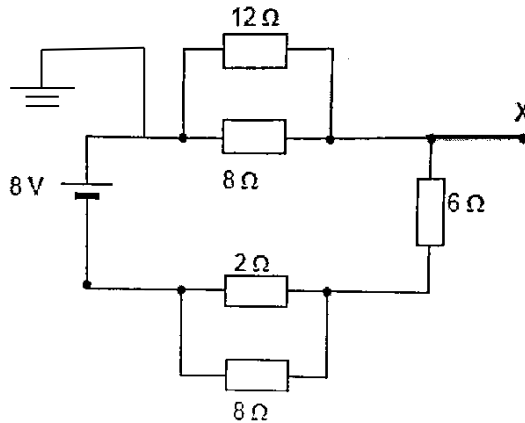
20. A lamp rated at 12 V and 24 W is used with a 10 V supply for 2 s. What is the energy transferred in the lamp?

- A** 20 J **B** 24 J **C** 33 J **D** 40 J

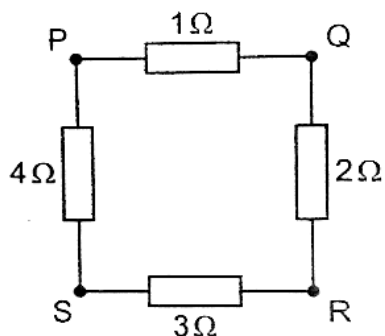
21. A 6.0 V battery is connected to three resistors of resistance R , and a variable resistor T as shown. The resistance of T changes from R to 0Ω . What is the change in the reading of the high resistance voltmeter?



- A No change B 2.0 V C 3.0 V D 6.0 V
22. What is the potential at point X?



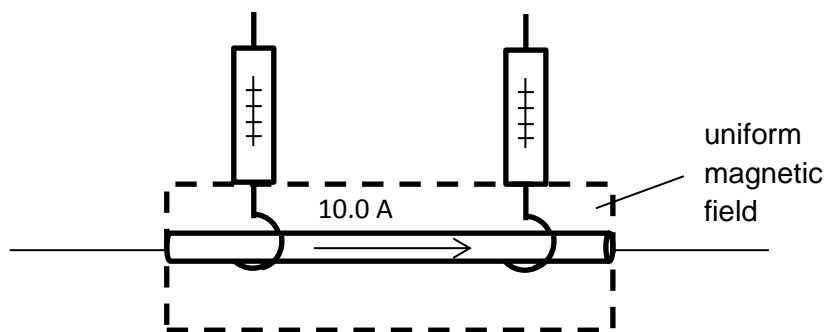
- A -3.1 V B 3.1 V C -4.9 V D 4.9 V
23. Four resistors are connected as shown.



Between which points is the combined resistance a minimum?

- A P and R B P and S C R and S D P and Q

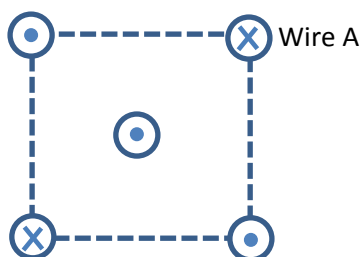
24. A 10.0 cm long wire is suspended from two spring balances as shown below.



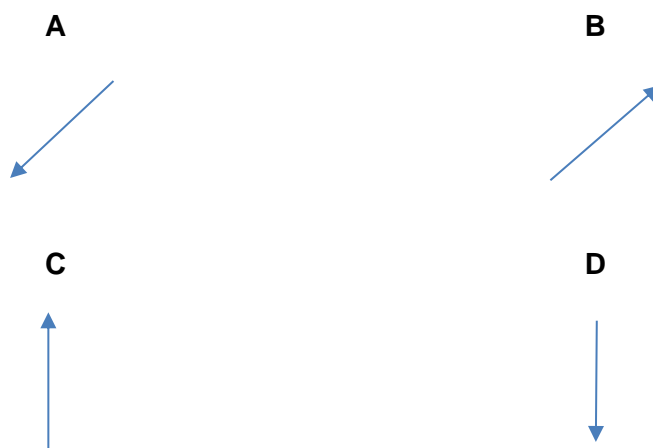
The direction of the magnetic field is pointing perpendicularly into the paper and the magnitude of the flux density is 1.00×10^{-3} T.

When there is no current in the wire, the reading on each spring balance is 10.00 g. What is the reading on the spring balance when a current of 10.0 A flows through the wire?

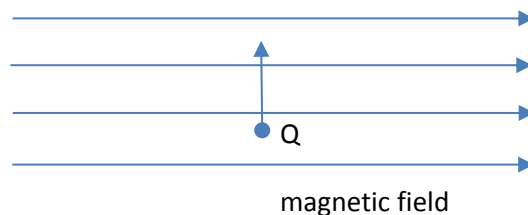
- A 9.90 g B 9.95 g C 10.05 g D 10.10 g
25. The diagram shows a horizontal plane through which five long straight vertical wires pass. Wire A carries a current into the paper. All the wires carry the same amount of current.



In which direction is the force on wire A?



26. A neutron, Q, is moving upwards in a magnetic field as shown below. What is the direction of the resultant force on the particle?

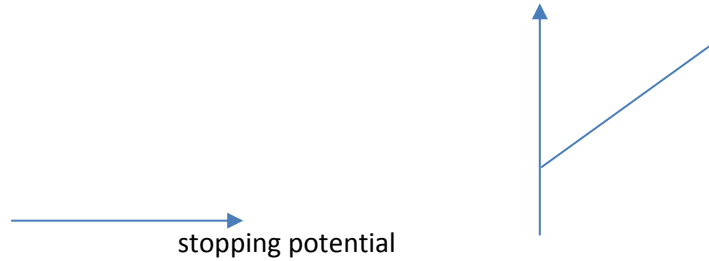


- A** Into the plane of the paper
B Out of the plane of the paper
C Downwards
D No force
27. A simple model of the energy levels in an atom has only three levels; **X**, **Y** and **Z**. A transition from level **X** to level **Z** produces radiation of wavelength 280 nm; a transition from level **Y** to level **Z** produces a radiation of wavelength 200 nm. Which of the following deductions concerning this system of three energy levels is correct?
- A** The wavelength of radiation emitted in a transition between levels **X** and **Y** is 80 nm.
B The wavelength of radiation absorbed in a transition between levels **X** and **Y** is 80 nm.
C Level **Y** has a greater energy than levels **X** or **Z**.
D Levels **X** has a greater energy than levels **Y** or **Z**.
28. Which statement describing work function energy is correct?
- A** It is the minimum force required to extract an electron from a metal surface
B It is the energy of the incoming photon
C It is the difference between the energy of the incoming photon and the maximum kinetic energy of the photoelectron
D It is the sum of the energy of the incoming photon and the maximum kinetic energy of the photoelectron
29. A metallic surface is irradiated with red light causing emission of photoelectrons. What change occurs if yellow light is used instead?
- A** No electrons are emitted
B Less electrons are emitted
C The same amount of electrons is emitted
D More electrons are emitted

30. The graph shows incoming photon frequency versus stopping potential of emitted electrons for a certain metal surface.

What changes, if any, would occur in the graph for a metal of higher work function?

photon frequency



stopping potential

	Magnitude of gradient	Magnitude of x-intercept
A	Higher	Lower
B	Lower	Lower
C	Same	Lower
D	Same	Higher

END OF PAPER

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