2017-18 MOCK
F.6 PHY
PAPER 1A

TWGHs Wong Fut Nam College
MOCK Examination 2017-18

PHYSICS PAPER 1

8:30 am – 11:00 am (2 hours 30 minutes)
This paper must be answered in English

Setter: Leung Shu Kei 31 Jan 2018 (Wed)

GENERAL INSTRUCTIONS

(1) There are **TWO** Sections, A and B, in this Paper. You are advised to finish Section A in about 50 minutes.
(2) Section A consists of multiple-choice questions in this question book, while Section B contains conventional questions printed separately in Question-Answer Book **B**.
(3) Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book. **The Answer Sheet for Section A and Question-Answer Book for Section B will be collected separately at the end of the examination.**
(4) The diagrams in this paper are **NOT** necessarily drawn to scale.
(5) The last two pages of this question paper contain a list of data, formulae and relationships which you may find useful.

INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

(1) Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first write down the information required in the spaces provided on the **MC answer sheet**. No extra time will be given for writing down the required information after the 'time is up' announcement.
(2) When told to open this book, you should check that all the questions are there. Look for the words **'END OF SECTION A'** after the last question.
(3) All questions carry equal marks.
(4) **ANSWER ALL QUESTIONS.** You are advised to use an **HB pencil** to mark all your answers on the **MC Answer Sheet,** so that wrong marks can be completely erased with a rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.
(5) You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.
(6) No marks will be deducted for wrong answers.

Section A

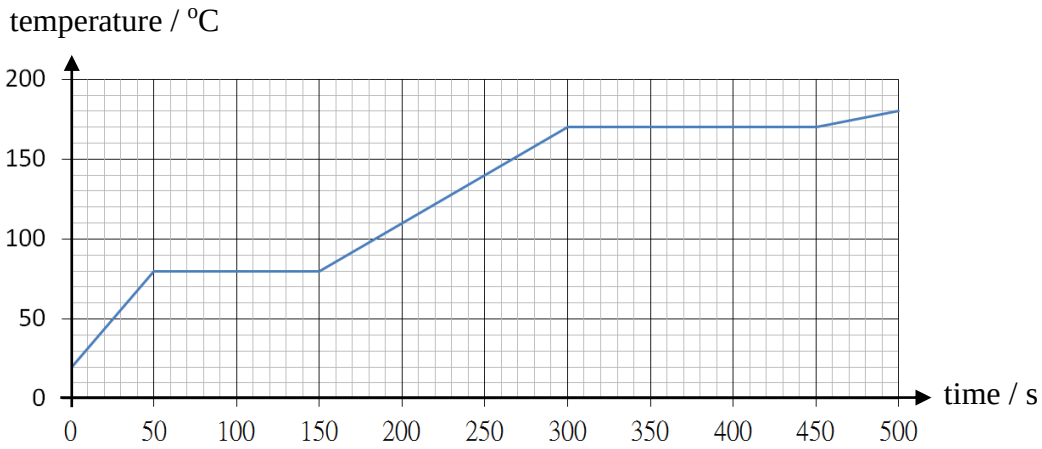
There are 33 questions. Questions Marked with "*" involve knowledge of the extension component.

1. A piece of ice at –10 ^{o}C turns into water at 20 ^{o}C. Which of the following statements is / are correct?

(1) The average KE of water molecules increases.
(2) The average potential energy of water molecule increases.
(3) Latent heat of fusion is released.

A. (1) and (2) only
B. (1) and (3)only
C. (2) and (3) only
D. (1), (2) and (3) only

2. A piece of solid wax is heated up at a constant rate. The variation of temperature with time is shown in the following temperature – time graph.



Which of the following statement(s) is / are correct?

(1) The specific latent heat of the fusion of the wax is smaller than the specific latent heat of vaporization of the wax.
(2) The ratio of the specific heat capacity of the wax in liquid state is smaller than that in solid state.
(3) The boiling point of the wax is 170 ^{o}C

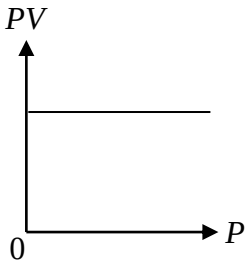
A. (1) and (2) only
B. (2) and (3) only
C. (1) and (3) only
D. (1), (2) and (3)

3. The pressure of the an ideal gas at – 73 ^{o}C is 0.6 $\times$ 10^5 Pa. The initial volume of the gas is 2000 cm^3. Find new volume of the gas when the temperature is increased to 27 ^{o}C and the pressure is increased to 1.8 $\times$ 10^5 Pa.

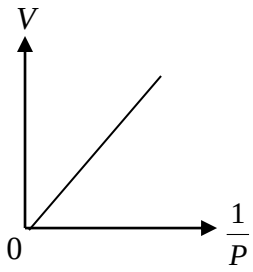
A. 3760 cm^3
B. 3000 cm^3
C. 1760 cm^3
D. 1000 cm^3

4. Which of the following diagram(s) best represents the behaviour of an ideal gas of fixed mass and at constant temperature? (P: gas pressure, V: volume of the gas)

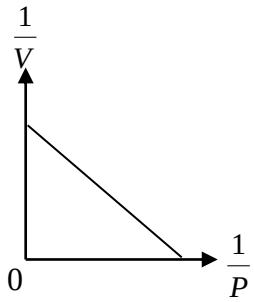
(1)



(2)



(3)



A. (2) only
B. (3) only
C. (1) and (2) only
D. (1) and (3) only

*5. 5 moles of a monatomic ideal gas is trapped in a container of volume 0.4 m^3 and at a pressure of 0.8 $\times$ 10^5 Pa. Find the average kinetic energy of the gas molecule.

A. 6.0 $\times$ 10^4 J
B. 9.6 $\times$ 10^3 J
C. 1.59 $\times$ 10^{-20} J
D. 3.99 $\times$ 10^{-19} J

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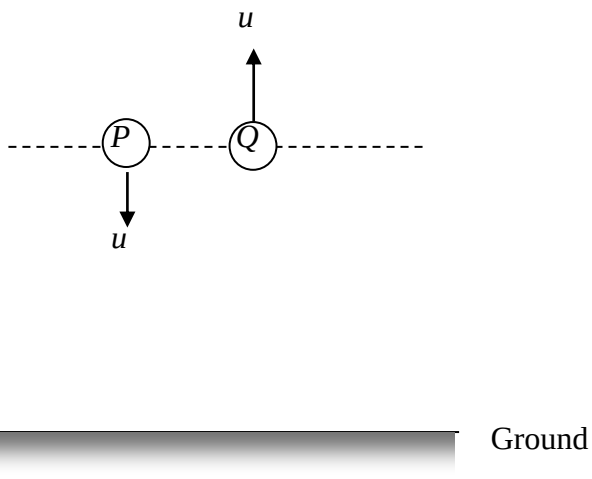
6. Ball *P* and *Q* are thrown from the same level above the ground at the same time as shown below.

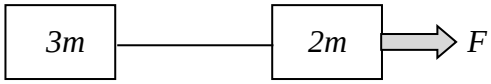
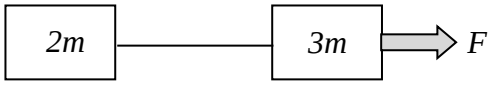


Ball *P* is thrown down with a speed *u* while ball *Q* is thrown up with the same speed *u*. Neglect the effects of air resistance. Which of the following statement(s) MUST be true?

(1) Ball *P* and *Q* both take the same time to reach the ground.
(2) Ball *P* and *Q* both have the same velocity when they reach the ground.
(3) Ball *P* and *Q* both have the same displacement when they reach the ground.

A. (1) and (2) only
B. (2) and (3) only
C. (1) and (3) only
D. (1), (2) and (3)

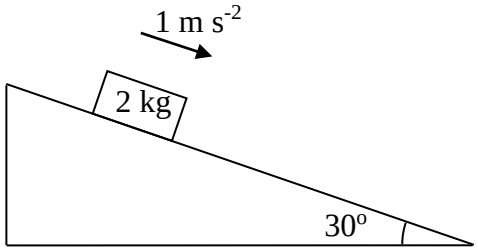
7. Two blocks with masses 3*m* and 2*m* are connected by an inextensible light string. They are pulled by a force *F* to move on a horizontal smooth surface in two different ways as shown below.

Case 1:		Tension in the string is T_1
Case 2:		Tension in the string is T_2

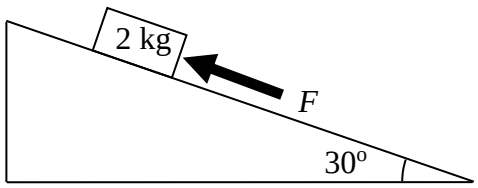
Find the ratio of $T_1 : T_2$.

A. 1 : 1
B. 2 : 3
C. 3 : 2
D. 4 : 9

8. A wooden block of mass 2 kg is placed on a rough inclined plane with angle of inclination of 30°. It slides down the plane with an acceleration of 1 m s^{-2} as shown below.



Now a force F is applied upwards along the inclined plane to keep the block at rest.



What is the maximum value of *F* so that the block remains at rest?

A. 2 N
B. 17.6 N
C. 19.6 N
D. 27.4 N

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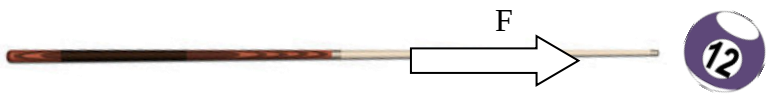
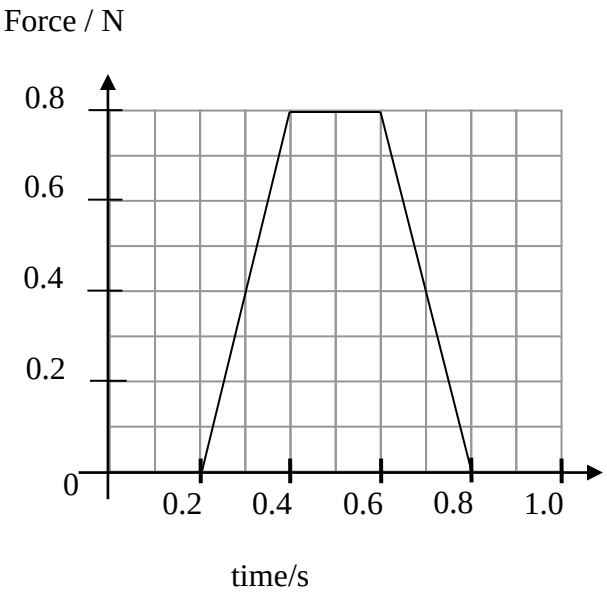
9. A snooker ball of mass 0.16 kg is pushed by a cue as shown below.



The snooker ball is initially at rest and the force F applying on the ball is shown in the following Force – time graph



Find the final speed of the snooker ball.

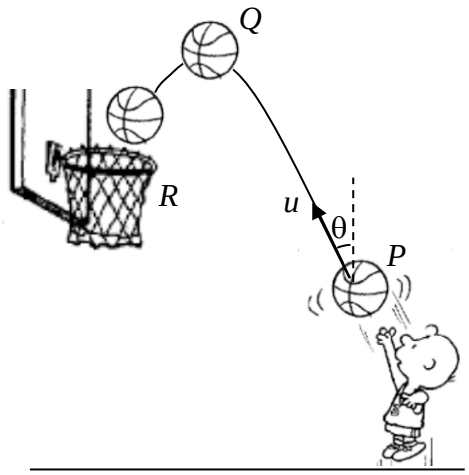
A. 0.5 m s^{-1}

B. 1 m s^{-1}

C. 2 m s^{-1}

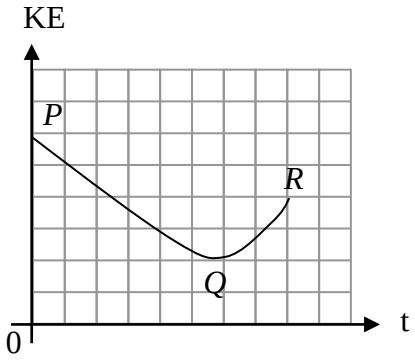
D. 4 m s^{-1}

*10. Charlie shoots a basketball from point *P* with an initial velocity *u* at an angle θ to the vertical as shown.

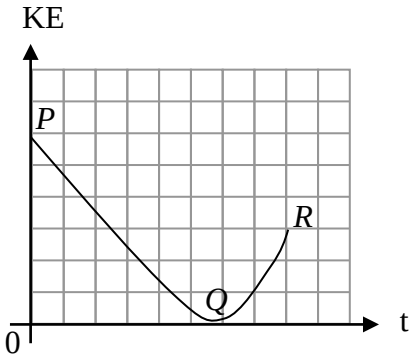


The ball reaches the highest point at *Q* and then passes through the hoop from above at point *R*. Which of the following graphs best represents the variation of KE of the ball with time t?

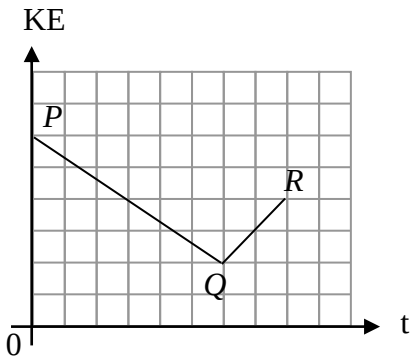
A.



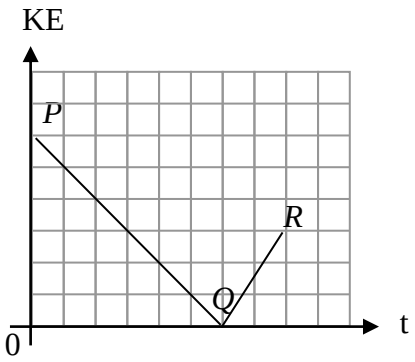
B.



C.



D.



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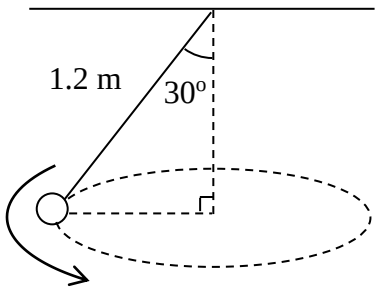
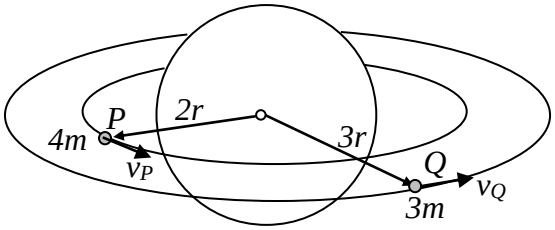
*11 A bob of mass 0.4 kg is hung from the ceiling by an inextensible string of length 1.2 m. It is performing uniform circular motion in a horizontal path. The angle between the string and the vertical is 30°.



What is the period of the circular motion?

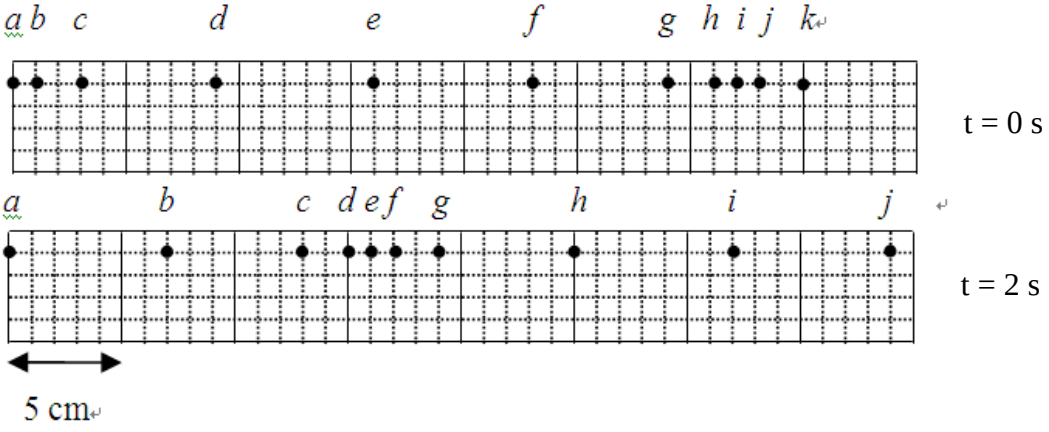
A. 0.98 s
B. 1.52 s
C. 1.96 s
D. 2.05 s

*12 Two satellites *P* and *Q* of masses *4m* and *3m* are orbiting around the Earth in two circular orbits with radius *2r* and *3r* respectively. What is the ratio of their speeds (v_P : v_Q)?



A. 3 : 2
B. $\sqrt{3}$: $\sqrt{2}$
C. $\sqrt{2}$: 1
D. 2 : 1

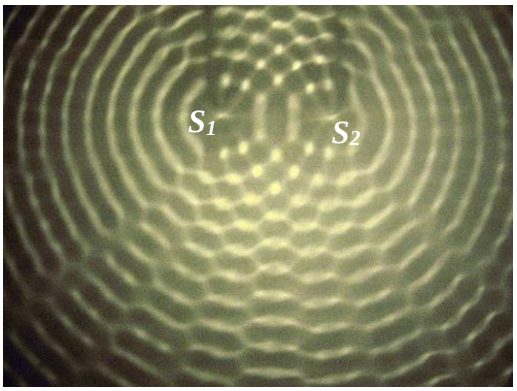
13.



A series of particles is uniformly distributed along a slinky spring initially. The positions of the particles at t = 0 s and t = 2 s are shown in the above diagrams. The wave propagates along the slinky spring from right to left. Which of the following statements **MAY NOT BE CORRECT**?

A. Particle ***e*** is moving to the left at t = 2 s.
B. Particle ***e*** and ***i*** are in anti-phase.
C. The wavelength of the wave is 32 cm.
D. The period of the wave is 4 s.

14. Two coherent sources S_1 and S_2, which are vibrating in phase, produce water waves. The interference pattern produced is shown below.



Which of the following modification(s) can increase the number of antinodal line formed?

A. Increase the depth of water in the water tank.
B. Decrease the separation between S_1 and S_2.
C. Increase the frequency of vibration.
D. Decrease the amplitude of vibration.

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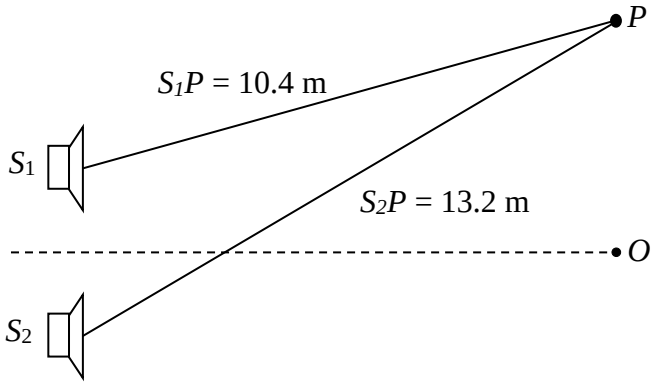
15. Loudspeakers S_1 and S_2 connected to a signal generator emit sound waves which are in phase. Point O is equidistant from the loudspeakers while at point P minimum loudness is detected.



The wavelength of the sound waves is 0.8 m. Which of the following statement(s) is / are CORRECT?

(1) Three points of maximum loudness, other than point O, can be detected in the region between O and P.
(2) Maximum loudness will be detected at P if the frequency of the sound is doubled.
(3) The loudness detected at point P will be increased if the loudspeaker S_2 is turned off.

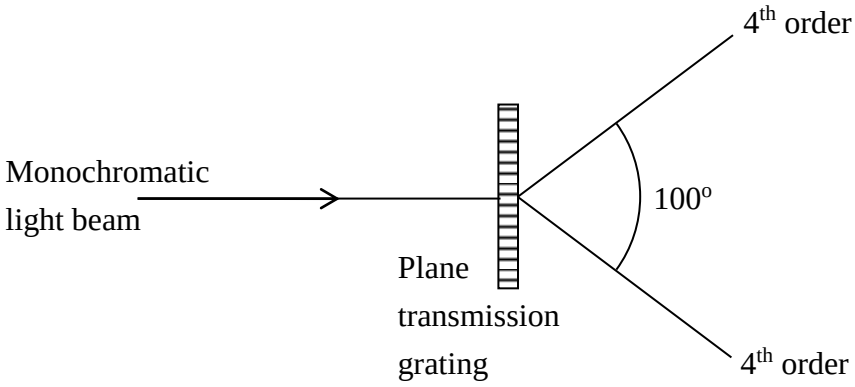
A. (1) and (2) only
B. (2) and (3) only
C. (1) and (3) only
D. (1), (2) and (3)

16. Wifi router and infrared TV remote control are common devices used at home.
In using the infrared TV remote, you have to point it directly to the TV while the wifi signal from the router can be received even the router is out of sight.

Which of the followings is the correct explanation of this observation?

A. The speed of infrared is much slower than that of the microwave.
B. The wavelength of the infrared is much shorter than that of the microwave.
C. Microwave is an electromagnetic wave.
D. Microwave refracts more than that of the infrared.

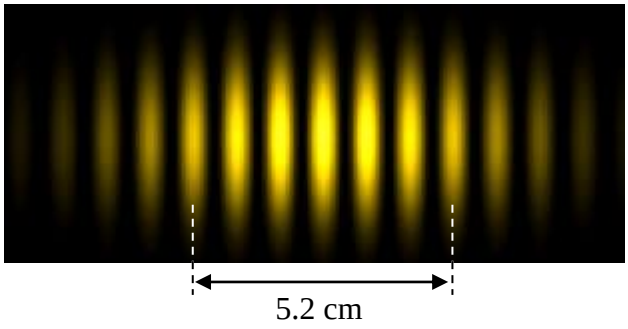
*17. A beam of monochromatic light is directed normally on a plane transmission grating. The angle between the two 4th order bright fringes is 100°



What is the maximum number of bright fringes that can be observed?

A. 4
B. 5
C. 9
D. 11

*18. A monochromatic light of wavelength 620 nm is illuminated to a double slits. An interference pattern is formed on a screen which is 0.8 m away as shown below.



What is the slit separation of the double slits?

A. 0.057 mm
B. 0.114 mm
C. 0.286 mm
D. 0.343 mm

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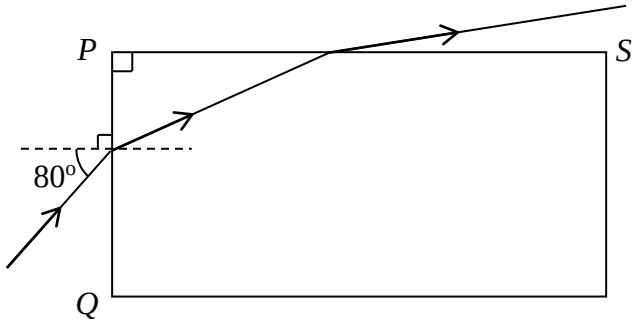
19. A ray of light enters a rectangular transparent block from air at side *PQ* as shown below. The light ray travels through the block and emerges into air at side *PS*. Which of the following(s) is / are the possible refractive index of the transparent block?



(Not drawn in scale)

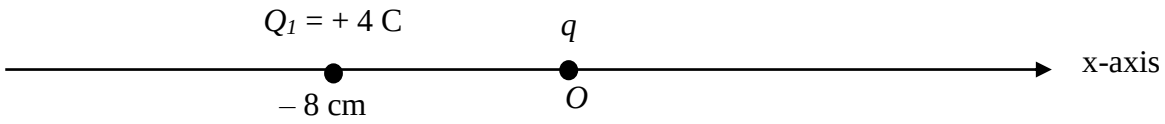
(1) n = 1.3
(2) n = 1.5
(3) n = 1.6

A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

20. Which of the following statements is **CORRECT**?

A. Red light travels faster blue light in water.
B. Ultrasound cannot be diffracted.
C. α radiation cannot travel in vacuum.
D. Ultraviolet is a longitudinal wave.

21. The diagram below shows an unknown point charge q placed at the origin O on the x-axis. A point charge Q_1, with charge +4 C, is fixed at a point at $x = -8$ cm on the x-axis. Another point charge Q_2 with – 2 C charge is now fixed on the x-axis in order to make the net force on q becomes zero.



Where should Q_2 be fixed?

A. $+ 4\sqrt{2}$ cm

B. $- 4\sqrt{2}$ cm

C. + 4 cm

D. – 4 cm

22. A cylindrical graphite rod has a cross-sectional area $A = 1.2 \times 10^{-5}$ m^2 and length $l = 0.2$ m. When it is connected to a battery of terminal p.d. $V = 0.4$ V, there will be 2.4 C of electrons passes through the graphite rod in each minute. Find the resistivity of the graphite.

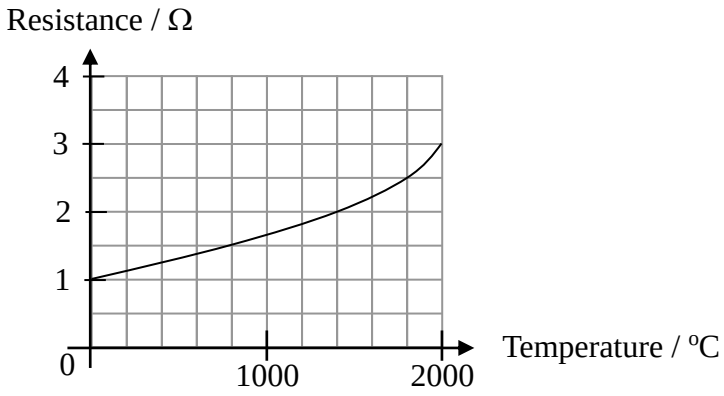
A. 1.0×10^{-4} Ω m

B. 2.0×10^{-4} Ω m

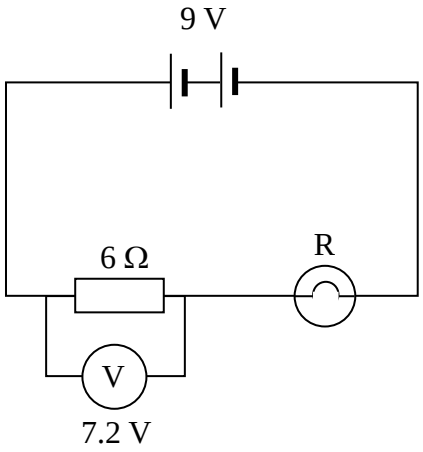
C. 3.0×10^{-4} Ω m

D. 6.0×10^{-4} Ω m

23. The variation of resistance of a lamp bulb with its temperature is shown in the following graph.



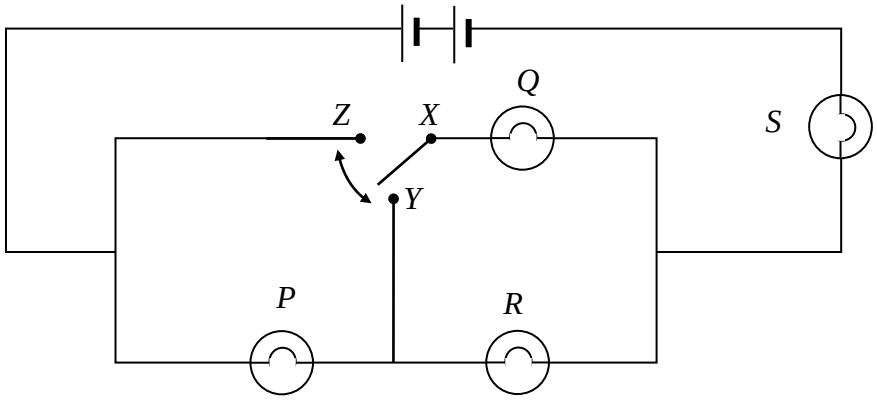
The lamp bulb is connected in series with a resistor of fixed resistance of 6 Ω and the potential difference across the fixed resistor is measured by an ideal voltmeter.



What is the temperature of the lamp bulb if the voltage measured by the voltmeter is 7.2 V?

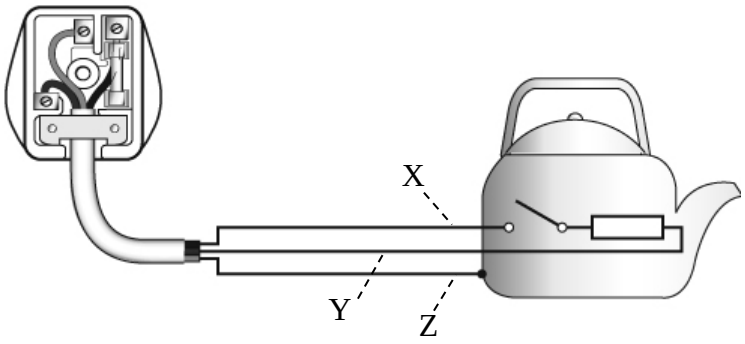
A. 800 ºC
B. 1400 ºC
C. 1800 ºC
D. 2000 ºC

24. In the above circuit, all the bulbs are identical and the battery is ideal. At the beginning, the two-ways switch is connected across *X Y*. Then, the two-ways switch is connected across *XZ*.
Which of the followings is correct?



A. Bulb P becomes brighter.
B. There is no change in brightness of bulb *Q*.
C. There is no change in brightness of bulb *R*.
D. Bulb *S* becomes dimmer.

25. The diagram below shows an electric kettle and a three-pin plug.



Due to some mistakes, the wire X is connected to neutral while the wire Y is connected to live accidentally. What would happen if the switch is closed?

A. Short circuit happens.
B. The fuse in the three-pin plug will be blown.
C. The fuse does not function and the kettle becomes overloaded.
D. The kettle still operates.

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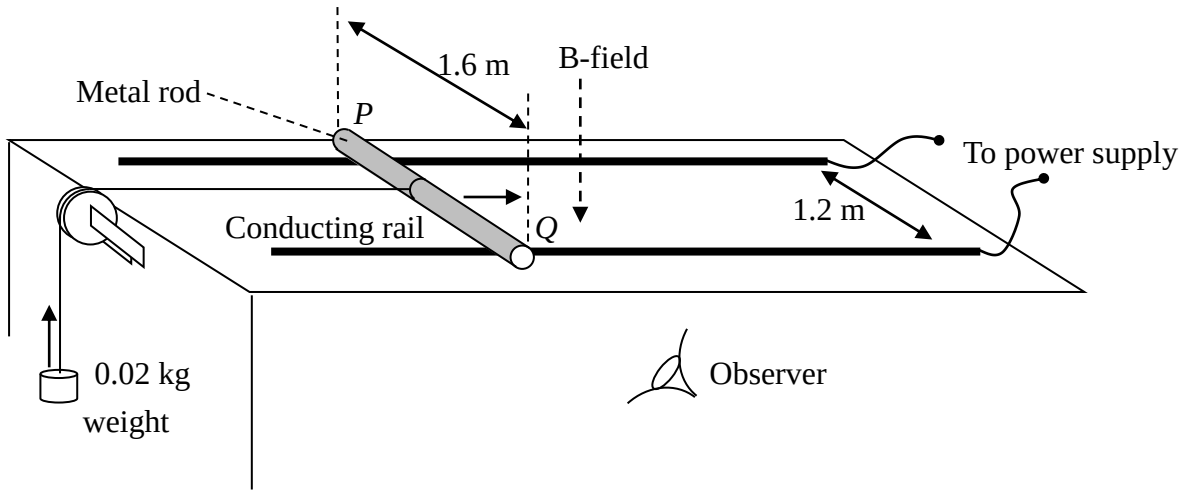
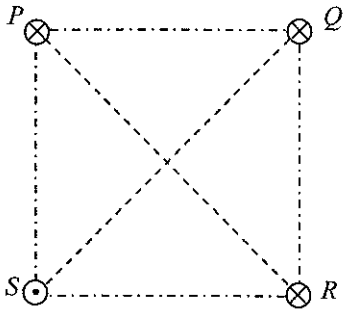
26. A metal rod *PQ* is placed on a pair of smooth conducting rails which is connected to a power supply. The whole set up is placed in a uniform magnetic field B = 50 mT as shown below. A 0.02 kg weight is hung by a string which is tied up to the rod through a smooth pulley.



The weight moves up with a uniform speed of 0.05 m s^{-1}. Find the magnitude of the current flow and the direction of current passing through the rod as view by the observer.

	Magnitude	Direction
A.	2.45 A	*P* to *Q*
B.	3.27 A	*Q* to *P*
C.	2.45 A	*Q* to P
D.	3.27A	*P* to *Q*

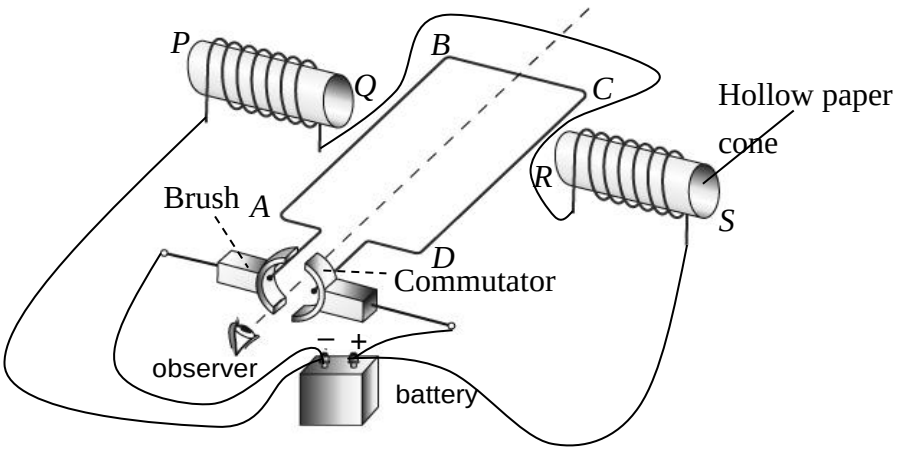
27.



Four long straight parallel wires *P*, *Q*, *R* and *S* carrying currents of equal magnitude are situated at the vertices of a square as shown. *P*, *Q* and *R* each carries a current directed into the paper while *S* carries a current directed out of the paper.
What is the direction of the resultant magnetic force acting on the wire *S*?

A. ↗
B. ↙
C. ↖
D. ↘

28. The diagram below shows a model motor connected to a battery.



Which of the followings is correct?

A. The coil *ABCD* is rotating in clockwise direction as view by the observer.
B. The **net force** acting on the coil is greatest when the coil *ABCD* is horizontal.
C. The motor does not work when the battery is replaced by an a.c. supply.
D. The direction of rotation of the coil will be reversed if the polarities of the battery are reversed.

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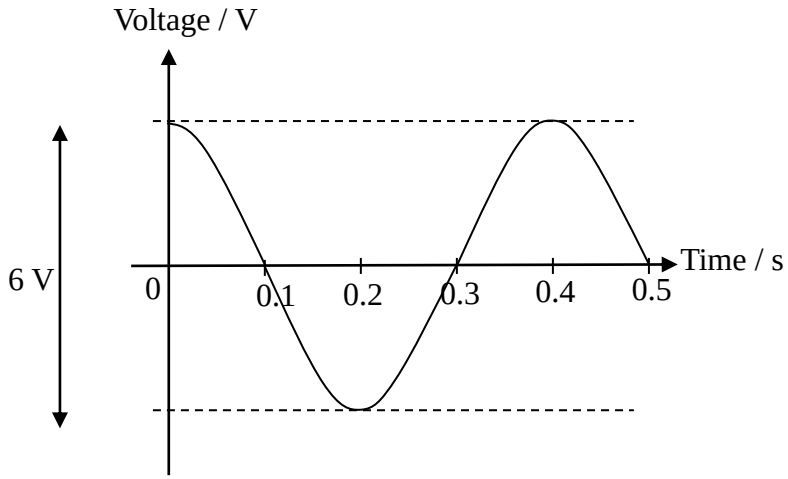
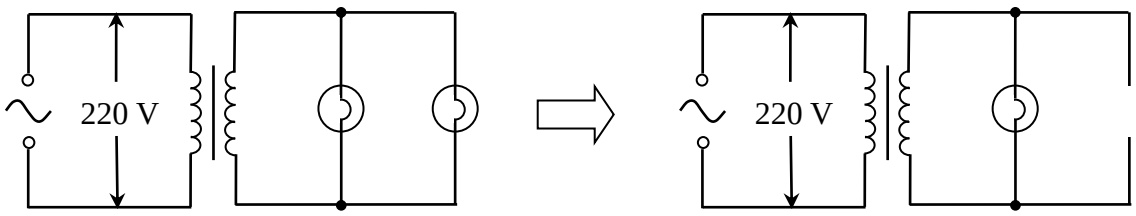
*29. A sinusoidal a.c. signal is applied to a resistor of resistance 5 Ω.



What is the total energy dissipated by the resistor in 20 s?

A. 7.2 J
B. 12.7 J
C. 18.0 J
D. 28.8 J

*30. In the circuit below, each light bulb works at its rated value '22 W, 11 V' and the efficiency of the transformer is 80 %. Suddenly, one of the lamp bulbs burns out and becomes open.



Assume that the remaining lamp bulb still operates at its rated value and the efficiency of the transformer remains unchanged. Which of the following statements is correct?

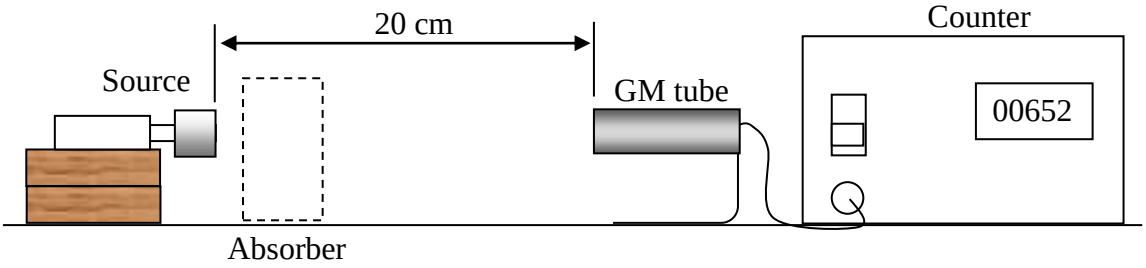
A. Before the lamp bulb burns out, the current flowing in the primary circuit is 0.25 A.
B. The turn ratio of the transformer is 10 : 1.
C. The current flowing in the primary circuit increases after the lamp bulb burns out.
D. The current passing through the remaining lamp bulb in the secondary circuit increases after the lamp bulb burns out.

31. Which following statement(s) about the nuclear radiation is / are correct?

(1) α radiation cannot be used in thickness gauge since its penetrating power is too weak.
(2) β radiation can be detected by photographic film.
(3) γ radiation can only be stopped by lead plate.

A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

32. Tom tries to find out the radiation emitted from a radioactive source by the following experiment.



The source is placed **<u>20 cm away</u>** from a Geiger–Muller counter. Different absorbers are placed in turns between the source and the counter. The experimental results are tabulated as follows:

Absorber	**Count rate / counts min^{-1}**
None	1617
A piece of paper	1621
An aluminum sheet of 5 mm thick	63
A lead plate of 2 cm thick	61
A lead plate of 10 cm think	62

Which of the following(s) **MUST** be correct?

(1) The source does not emit α radiation
(2) The source emits β radiation
(3) The source emits γ radiation

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

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*33. The following equation shows a nuclear reaction that may occur in a nuclear reactor.

$$^{235}_{92}\mathrm{U} + ^{1}_{0}\mathrm{n} \rightarrow ^{137}_{55}\mathrm{Cs} + ^{95}_{37}\mathrm{Rb} + 4\,^{1}_{0}\mathrm{n}$$

The energy released in the reaction is 169.0193 MeV.

Given:

Nuclide	Atomic mass / u
$^{235}_{92}\mathrm{U}$	235.043 930
$^{95}_{37}\mathrm{Rb}$	94.929 303
$^{1}_{0}\mathrm{n}$	1.008 664

Find the mass of $^{137}_{55}\mathrm{Cs}$.

A. 137.915753 u
B. 137.270181 u
C. 137.088635 u
D. 136.907089 u

END OF SECTION A

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List of data, formulae and relationships

Data

molar gas constant	$R = 8.31\ J\ mol^{-1}\ K^{-1}$
Avogadro constant	$N_A = 6.02\times10^{23}\ mol^{-1}$
acceleration due to gravity	$g = 9.81\ m\ s^{-2}$ (close to the Earth)
universal gravitational constant	$G = 6.67\times10^{-11}\ N\ m^2\ kg^{-2}$
speed of light in vacuum	$c = 3.00\times10^{8}\ m\ s^{-1}$
charge of electron	$e = 1.60\times10^{-19}\ C$
electron rest mass	$m_e = 9.11\times10^{-31}\ kg$
permittivity of free space	$\varepsilon_o = 8.85\times10^{-12}\ C^2\ N^{-1}\ m^{-2}$
permeability of free space	$\mu_o = 4\pi\times10^{-7}\ H\ m^{-1}$
atomic mass unit	$u = 1.661\times10^{-27}\ kg$ (1 u is equivalent to 931 MeV)
astronomical unit	$AU = 1.50\times10^{11}\ m$
light year	$ly = 9.46\times10^{15}\ m$
parsec	$pc = 3.09\times10^{16}\ m = 3.26\ ly = 206265\ AU$
Stefan constant	$\sigma = 5.67\times10^{-8}\ W\ m^{-2}\ K^{-4}$
Planck constant	$h = 6.63\times10^{-34}\ J\ s$

Rectilinear motion

For uniformly accelerated motion:

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

Mathematics

Equation of straight line	$y = mx + c$
Arc length	$= r\theta$
Surface area of cylinder	$= 2\pi rh + 2\pi r^2$
Volume of cylinder	$= \pi r^2 h$
Surface area of sphere	$= 4\pi r^2$
Volume of sphere	$= \frac{4}{3}\pi r^3$

For small angles, $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

Astronomy and Space Science

$U = -\frac{GMm}{r}$	gravitational potential energy
$p = \sigma AT^4$	Stefan's law
$\left\|\frac{\Delta f}{f_o}\right\| \approx \frac{v}{c} \approx \left\|\frac{\Delta\lambda}{\lambda_o}\right\|$	Doppler effect

Energy and Use of Energy

$E = \frac{\Phi}{A}$	illuminance
$\frac{Q}{t} = k\frac{A(T_H - T_C)}{d}$	rate of energy transfer by conduction
$U = \frac{k}{d}$	thermal transmittance U-value
$P = \frac{1}{2}\rho Av^3$	maximum power by wind turbine

Atomic World

$\frac{1}{2}m_e v_{\max}^2 = hf - \Phi$	Einstein's photoelectric equation
$E_n = \frac{1}{n^2}\left\{\frac{m_e e^4}{8h^2\varepsilon_o^2}\right\} = -\frac{13.6}{n^2}eV$	energy level equation for hydrogen atom
$\lambda = \frac{h}{p} = \frac{h}{mv}$	de Broglie formula
$\theta = \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)

Medical Physics

$\theta = \frac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)
$power = \frac{1}{f}$	power of lens
$L = 10\log\frac{I}{I_o}$	intensity level (dB)
$Z = \rho c$	acoustic impedance
$\alpha = \frac{I_r}{I_o} = \frac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$	intensity reflection coefficient
$I = I_o e^{-\mu x}$	transmitted intensity through a medium

A1.	$E = mc\Delta T$	energy transfer during heating and cooling
A2.	$E = l\Delta m$	energy transfer during change of state
A3.	$pV = nRT$	equation of state for ideal gas
A4.	$pV = \frac{1}{3}Nm\overline{c^2}$	kinetic theory equation
A5.	$E_k = \frac{3RT}{2N_A}$	molecular kinetic energy

B1.	$F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$	Force
B2.	$moment = F \times d$	moment of a force
B3.	$E_p = mgh$	gravitational potential energy
B4.	$E_k = \frac{1}{2}mv^2$	kinetic energy
B5.	$P = Fv$	mechanical power
B6.	$a = \frac{v^2}{r} = \omega^2 r$	centripetal acceleration
B7.	$F = \frac{Gm_1m_2}{r^2}$	Newton's law of gravitation

C1.	$\Delta y = \frac{\lambda D}{a}$	fringe width in double-slit interference
C2.	$d\sin\theta = n\lambda$	diffraction grating equation
C3.	$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$	equation for a single lens

D1.	$F = \frac{Q_1Q_2}{4\pi\varepsilon_o r^2}$	Coulomb's law
D2.	$E = \frac{Q}{4\pi\varepsilon_o r^2}$	electric field strength due to a point charge
D3.	$E = \frac{V}{d}$	electric field between parallel plates (numerically)
D4.	$R = \frac{\rho l}{A}$	resistance and resistivity
D5.	$R = R_1 + R_2$	resistor in series
D6.	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	resistor in parallel
D7.	$P = IV = I^2R$	power in a circuit
D8.	$F = BQv\sin\theta$	force on a moving charge in a magnetic field
D9.	$F = BIl\sin\theta$	force on a current-carrying conductor in a magnetic field
D10.	$B = \frac{\mu_o I}{2\pi r}$	magnetic field due to a long straight wire
D11.	$B = \frac{\mu_o NI}{l}$	magnetic field inside a long solenoid
D12.	$\varepsilon = N\frac{\Delta\Phi}{\Delta t}$	induced e.m.f.
D13.	$\frac{V_s}{V_p} \approx \frac{N_s}{N_p}$	ratio of secondary voltage to primary voltage in a transformer

E1.	$N = N_o e^{-kt}$	law of radioactive decay
E2.	$t_{\frac{1}{2}} = \frac{\ln 2}{k}$	half-life and decay constant
E3.	$A = kN$	activity and the number of undecayed nuclei
E4.	$\Delta E = \Delta mc^2$	mass-energy relationship