HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

PHYSICS PAPER 1

(Sample Paper)

Time allowed: 2 hours 30 minutes

This paper must be answered in English

GENERAL INSTRUCTIONS

1. There are **TWO** sections, A and B, in this Paper. Section A consists of multiple-choice questions in this question book, while Section B contains conventional questions printed separately in Question-Answer Book B. You are advised to finish Section A in about 60 minutes.

2. 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 B. **The Answer Sheet for Section A and the Question-Answer Book for Section B must be handed in separately at the end of the examination.**

SECTION A (MULTIPLE-CHOICE QUESTIONS)

INSTRUCTIONS FOR SECTION A

1. Read the instructions on the Answer Sheet carefully. Stick a barcode label and insert the information required in the spaces provided.

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 should use an **HB** pencil to mark all your answers on the Answer Sheet. Wrong marks must be completely erased.

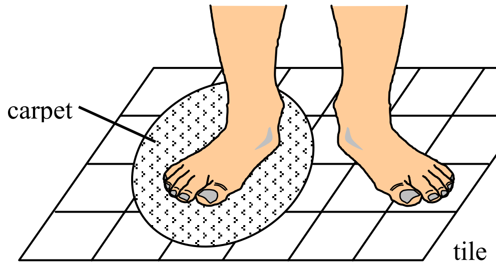
5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

6. No marks will be deducted for wrong answers.

Not to be taken away before the end of the examination session

There are 36 questions. Questions marked with "*" involve knowledge of the extension component. The back cover of this question paper contains a list of data, formulae and relationships which you may find useful.

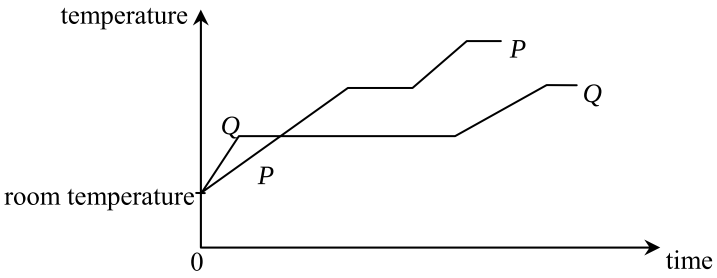
1.



Cynthia places a piece of carpet on a tiled floor. After a while, she stands in bare feet with one foot on the tiled floor and the other on the carpet as shown above. She feels that the tiled floor is colder than the carpet. Which of the following best explains this phenomenon ?

A. The tile is a better insulator of heat than the carpet.
B. The tile is at a lower temperature than the carpet.
C. The specific heat capacity of the tile is smaller than that of the carpet.
D. Energy transfers from Cynthia's foot to the tile at a greater rate than that to the carpet.

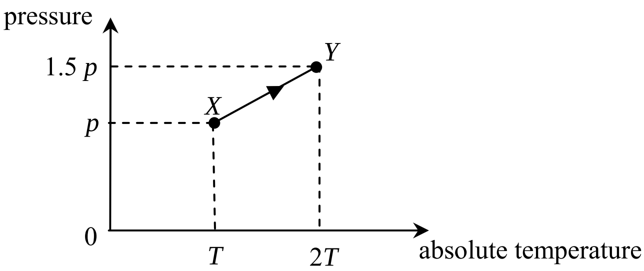
2.



The graph shows the variation in temperature of equal masses of two substances P and Q when they are separately heated by identical heaters. Which deduction is correct ?

A. The melting point of P is lower than that of Q.
B. The specific heat capacity of P in solid state is larger than that of Q.
C. The specific latent heat of fusion of P is larger than that of Q.
D. The energy required to raise the temperature of P from room temperature to boiling point is more than that of Q.

*3.



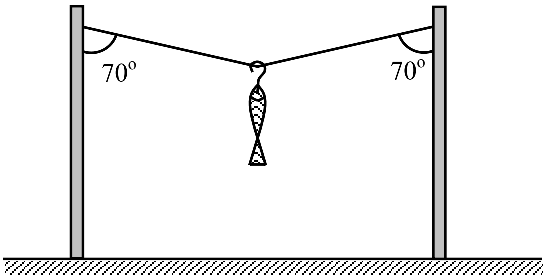
As the gas in a vessel of fixed volume is heated, it gradually leaks out. The gas in the vessel changes from state X to state Y along the path XY shown in the plot of pressure against absolute temperature. What percentage of the original mass of the gas leaks out from the vessel in this process ?

A. 10%
B. 20%
C. 25%
D. 50%

*4. Two vessels contain hydrogen gas and oxygen gas respectively. Both gases have the same pressure and temperature and are assumed to be ideal. Which of the following physical quantities must be the same for the two gases ?

A. The volume of the gas
B. The mass per unit volume of the gas
C. The r.m.s. speed of the gas molecules
D. The number of gas molecules per unit volume

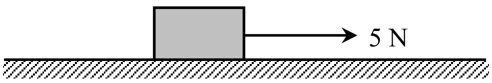
5.



A fish is hung on a light string as shown above. The tension in the string is 10 N. Find the total weight of the fish and the hook.

A. 20 sin 70° N
B. 20 cos 70° N
C. 10 sin 70° N
D. 10 cos 70° N

6.



A 1 kg block is pulled by a horizontal force of 5 N and moves with an acceleration of 2 m s^{-2} on a rough horizontal plane. Find the frictional force acting on the block.

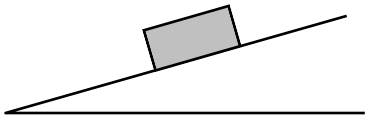
A. zero
B. 2 N
C. 3 N
D. 7 N

7. Patrick is driving along a straight horizontal road. At time t = 0, he observes that an accident has happened. He then applies the brakes to stop his car with uniform deceleration. The graph shows the variation of the speed of the car with time.

Find the distance travelled by the car from time $t = 0$ to 5.0 s.

A. 29.4 m
B. 40.6 m
C. 46.2 m
D. 81.2 m

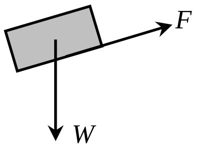
8.



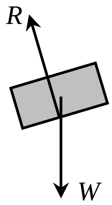
A block remains at rest on a rough inclined plane. Which diagram shows all the forces acting on the block ?

Note : W = gravitational force acting on the block,
R = normal reaction exerted by the inclined plane on the block, and
F = friction acting on the block.

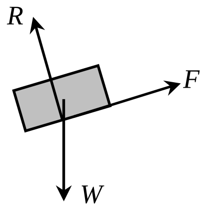
A.



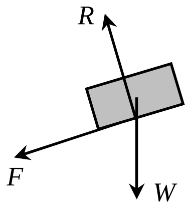
B.



C.



D.



9. Kelvin is standing on a balance inside a lift. The table shows the readings of the balance in three situations.

Motion of the lift	**Reading of the balance**
moving upwards with a uniform speed	R_1
moving downwards with a uniform speed	R_2
moving upwards with an acceleration	R_3

Which relationship is correct ?

A. $R_1 = R_2 > R_3$
B. $R_3 > R_1 = R_2$
C. $R_1 > R_2 > R_3$
D. $R_3 > R_1 > R_2$

10.

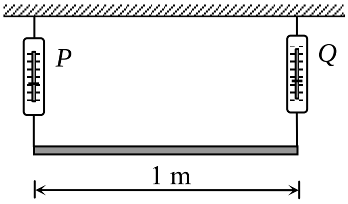


Figure (a)

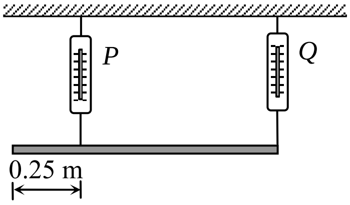


Figure (b)

Figure (a) shows a uniform plank supported by two spring balances P and Q. The readings of the two balances are both 150 N. P is now moved 0.25 m towards Q (see Figure (b)). Find the new readings of P and Q.

	Reading of P/N	**Reading of Q/N**
A.	100	200
B.	150	150
C.	200	100
D.	200	150

11. Which of the following pairs of forces is/are example(s) of action and reaction ?

(1) The centripetal force keeping a satellite in orbit round the earth and the weight of the satellite.
(2) The air resistance acting on an object falling through the air with terminal velocity and the weight of the object.
(3) The forces of attraction experienced by two parallel wires carrying currents in the same direction.

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

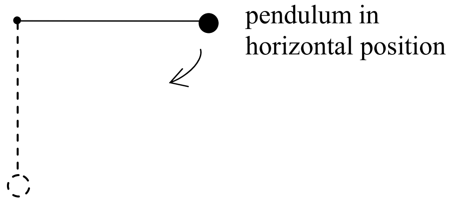
12. Two small identical objects *P* and *Q* are released from rest from the top of a building 80 m above the ground. *Q* is released 1 s after *P*. Neglecting air resistance, what is the maximum vertical separation between *P* and *Q* in the air ?

A. 5 m
B. 10 m
C. 35 m
D. 45 m

13. A car *P* of mass 1000 kg moves with a speed of 20 m s^{-1} and makes a head-on collision with a car *Q* of mass 1500 kg, which was moving with a speed of 10 m s^{-1} in the opposite direction before the collision. The two cars stick together after the collision. Find their common velocity immediately after the collision.

A. 2 m s^{-1} along the original direction of *P*
B. 2 m s^{-1} along the original direction of *Q*
C. 14 m s^{-1} along the original direction of *P*
D. 14 m s^{-1} along the original direction of *Q*

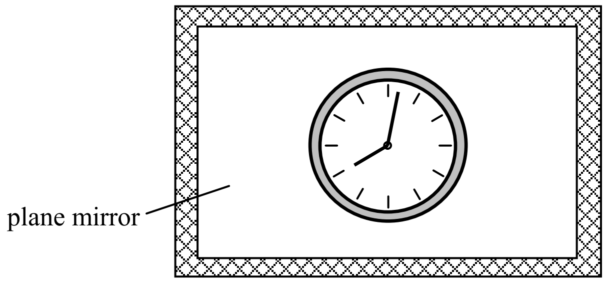
*14.



A simple pendulum is held at rest in a horizontal position. It is then released with the string taut. Which statement about the tension in the string is **not correct** when the pendulum reaches its vertical position ?

A. The tension equals the weight of the pendulum bob in magnitude.
B. The tension attains its greatest value.
C. The tension does not depend on the length of the pendulum.
D. The tension depends on the mass of the pendulum bob.

15.

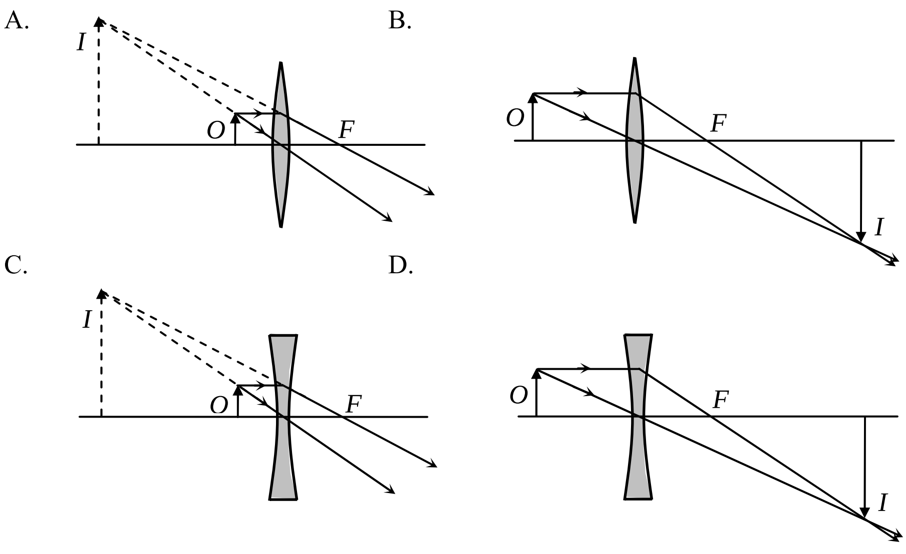


The diagram shows the image of a clock in a plane mirror. What is the time displayed by the clock ?

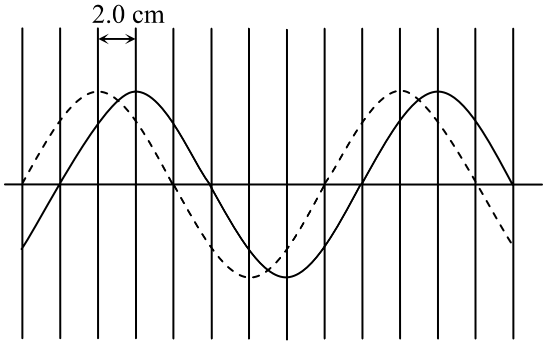
A. 3:58
B. 4:02
C. 7:58
D. 8:02

16.

Cecilia uses a magnifying glass to read some small print. Which diagram shows how the image of the print is formed ?



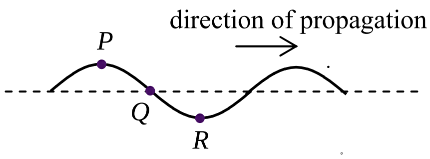
17.



The solid curve in the diagram shows a transverse wave at a certain instant. After 0.05 s, the wave has travelled a distance of 2.0 cm and is indicated by the dashed curve. Find the wavelength and frequency of the wave.

	Wavelength/cm	**Frequency/Hz**
A.	8	2.5
B.	16	2.5
C.	8	5
D.	16	5

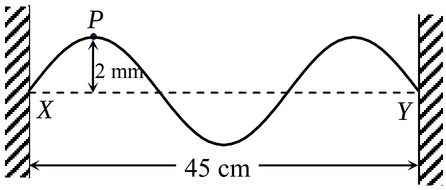
18.



The figure shows the shape of a transverse wave travelling along a string at a certain instant. Which statement about the motion of the particles *P*, *Q* and *R* on the string at this instant is correct ?

A. Particle *P* is moving downwards.
B. Particle *Q* is stationary.
C. Particle *R* attains its maximum acceleration.
D. *P* and *Q* are in phase.

19.



String *XY* is fixed at both ends. The distance between *X* and *Y* is 45 cm. Two identical sinusoidal waves travel along *XY* in opposite directions and form a stationary wave with an antinode at point *P*. The figure shows the string when *P* is 2 mm, its maximum displacement, from the equilibrium position. What is the amplitude and wavelength of each of the **travelling waves** on the string ?

	Amplitude	**Wavelength**
A.	1 mm	30 cm
B.	1 mm	15 cm
C.	2 mm	30 cm
D.	2 mm	15 cm

20. A Young's double-slit experiment was performed using a monochromatic light source. Which change would result in a greater fringe separation on the screen ?

(1) Using monochromatic light source of longer wavelength
(2) Using double slit with greater slit separation
(3) Using double slit with larger slit width

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

21. An object is placed at the focus of a concave lens of focal length 10 cm. What is the magnification of the image formed ?

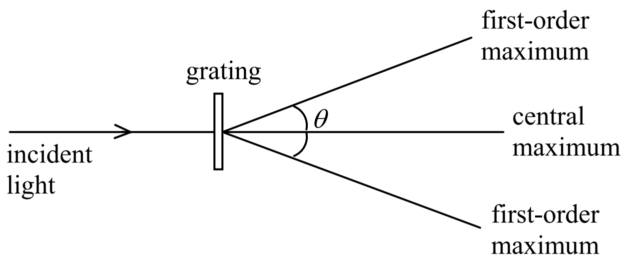
A. 0.5
B. 1.0
C. 2.0
D. infinite

22. Which of the following statements about sound waves is/are correct ?

(1) Sound waves are longitudinal waves.
(2) Sound waves are electromagnetic waves.
(3) Sound waves cannot travel in a vacuum.

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

23.

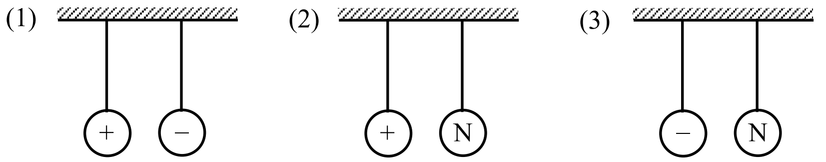


When monochromatic light is passed through a diffraction grating, a pattern of maxima and minima is observed as shown. Which combination would produce the largest angle θ between the first-order maxima ?

	Grating (lines per mm)	**Colour of light used**
A.	200	blue
B.	200	red
C.	400	blue
D.	400	red

24. Two conducting spheres are hanging freely in air by insulating threads. In which of the following will the two spheres attract each other ?

Note : 'N' denotes that the sphere is uncharged.



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

25. The table shows three electrical appliances which Clara used in a certain month :

Appliance	Rating	Duration
Air-conditioner	220 V, 1200 W	250 hours
television	220 V, 250 W	80 hours
computer	220 V, 150 W	60 hours

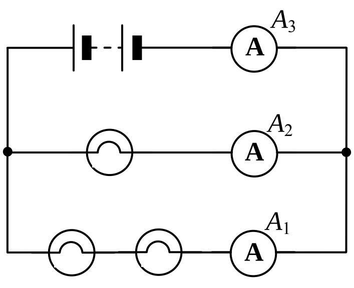
Calculate the cost of electricity used.
Note : 1 kW h of electricity costs $ 0.86.

A. $ 62.25
B. $ 73.79
C. $ 282.94
D. $ 536.64

26. If a 15 A fuse is installed in the plug of an electric kettle of rating '220 V, 900 W', state what happens when the kettle is plugged in and switched on.

A. The kettle will not operate.
B. The kettle will be short-circuited.
C. The output power of the kettle will be increased.
D. The chance of the kettle being damaged by an excessive current will be increase

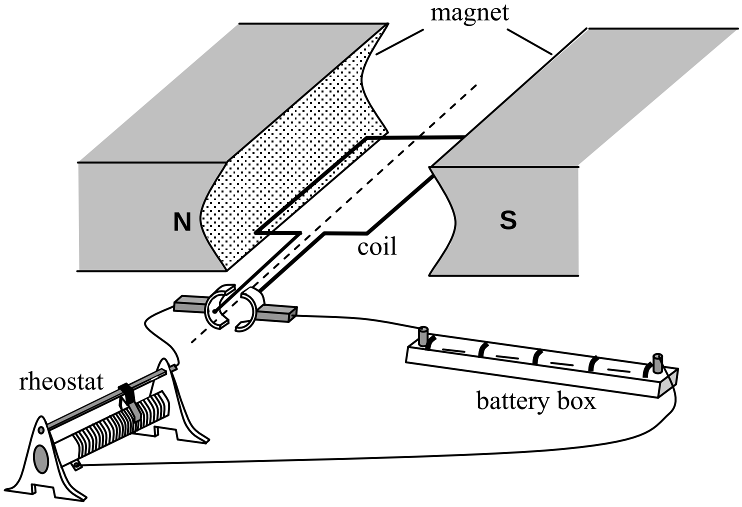
27.



In the above circuit, the bulbs are identical. The reading of ammeter A_1 is 1 A. Find the readings of ammeters A_2 and A_3.

	Reading of A_2	Reading of A_3
A.	2 A	2 A
B.	2 A	3 A
C.	0.5 A	1 A
D.	0.5 A	1.5 A

28.

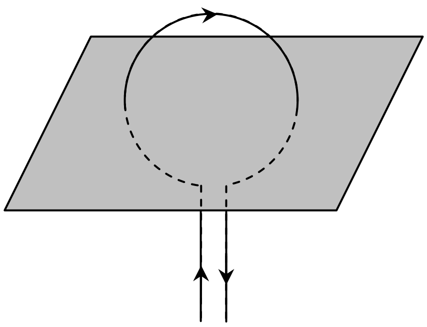


The figure shows a simple motor. Which of these changes would increase the turning effect of the coil ?

(1) using a stronger magnet
(2) reducing the resistance of the rheostat
(3) using a coil with a smaller number of turns

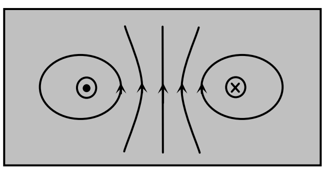
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

29.

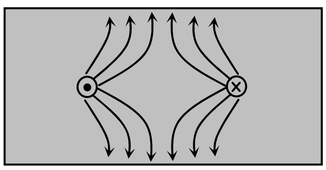


Which diagram shows the magnetic field pattern around a flat circular current-carrying coil, in the plane shown ?

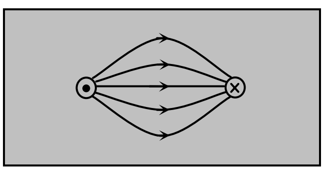
A.



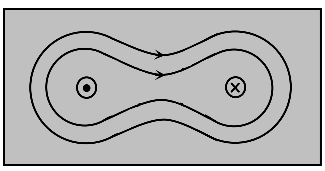
B.

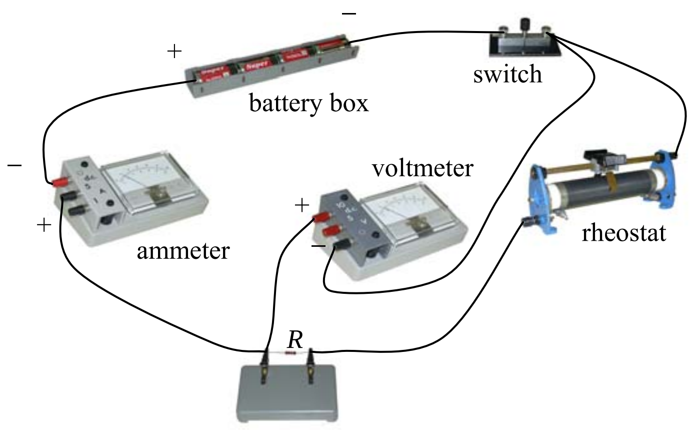


C.



D.

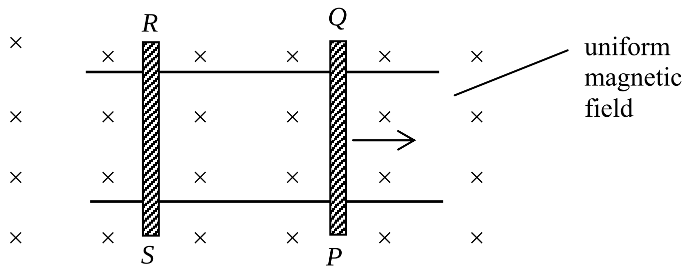


30. 

A student wants to measure the resistance of a resistor R and sets up the circuit shown. The student made which of these mistakes setting up the circuit ?

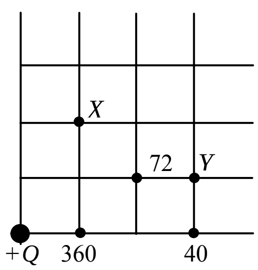
(1) The polarity of the ammeter was reversed.
(2) The polarity of the voltmeter was reversed.
(3) The voltmeter was connected across both R and the rheostat.

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

31. 

The figure shows conducting rods PQ and RS placed on two smooth, parallel, horizontal conducting rails. A uniform magnetic field is directed into the plane of the paper. PQ is given an initial velocity to the right and left to roll. Which statement is **INCORRECT** ?

A. The induced current is in the direction $PQRS$.
B. The magnetic force acting on rod PQ is towards the left.
C. Rod RS starts moving towards the right.
D. Rod PQ moves with a uniform speed.

32. 

The figure shows the location of an isolated charge of size $+Q$. The size (in an arbitrary unit) of the electric field strength is marked at certain points. What is the size (in the same arbitrary unit) of the electric field strength at X and Y ?

	electric field strength at *X*	**electric field strength at *Y***
A.	72	30
B.	72	36
C.	90	30
D.	90	36

*33. Power is transmitted over long distances at high alternating voltages. Which statements are correct ?

(1) Alternating voltages can be stepped up or down efficiently by transformers.
(2) For a given transmitted power, the current will be reduced if a high voltage is adopted.
(3) The power loss in the transmission cables will be reduced if a high voltage is adopted.

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

34. Which of these is a nuclear fusion reaction ?

A. ${}^{235}_{92}\mathrm{U} + \mathrm{n} \rightarrow {}^{144}_{56}\mathrm{Ba} + {}^{90}_{36}\mathrm{Kr} + 2\mathrm{n}$
B. ${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + \mathrm{n}$
C. ${}^{14}_{7}\mathrm{N} + \mathrm{n} \rightarrow {}^{14}_{6}\mathrm{C} + {}^{1}_{1}\mathrm{H}$
D. ${}^{238}_{92}\mathrm{U} \rightarrow {}^{234}_{90}\mathrm{Th} + \alpha$

*35. On which of the following does the activity of a radioactive source depend ?

(1) the nature of the nuclear radiation emitted by the source
(2) the half-life of the source
(3) the number of active nuclides in the source

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

36. Different absorbers are placed in turn between a radioactive source and a Geiger-Muller tube. Three readings are taken for each absorber. The following data are obtained:

Absorber	**Count rate / s^{-1}**		
–	200	205	198
paper	197	202	206
5 mm aluminium	112	108	111
25 mm lead	60	62	58
50 mm lead	34	36	34

What type(s) of radiation does the source emit ?

A. β only
B. γ only
C. β and γ only
D. α, β and γ

END OF SECTION A

List of data, formulae and relationships

Data

speed of light in vacuum	$c = 3.00 \times 10^{8}$ m s^{-1}
acceleration due to gravity	$g = 9.81$ m s^{-2} (Close to the Earth)
universal gravitational constant	$G = 6.67 \times 10^{-11}$ N m^{2} kg^{-2}
charge of electron	$e = 1.60 \times 10^{-19}$ C
electron rest mass	$m_e = 9.11 \times 10^{-31}$ kg
permittivity of free space	$\varepsilon_o = 8.85 \times 10^{-12}$ C^{2} N^{-1} m^{-2}
permeability of free space	$\mu_o = 4\pi \times 10^{-7}$ H m^{-1}
Planck constant	$h = 6.63 \times 10^{-34}$ J s
molar gas constant	$R = 8.31$ J K^{-1} mol^{-1}
Stefan constant	$\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}
Avogadro constant	$N_A = 6.02 \times 10^{23}$ mol^{-1}
atomic mass unit (1 u is equivalent to 931 MeV)	u = 1.661×10^{-27} kg

Rectilinear motion

For uniformly accelerated motion :

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Mathematics

Equation of a 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)

A1.	$E = mc\,\Delta T$	energy transfer during heating and cooling	D3.	$V = \dfrac{Q}{4\pi\varepsilon_0 r}$	electric potential due to a point charge
A2.	$E = l\,\Delta m$	energy transfer during change of state	D4.	$E = \dfrac{V}{d}$	energy field between parallel plates (numerically)
A3.	$pV = nRT$	equation of state for an ideal gas	D5.	$I = nA\upsilon Q$	general current flow equation
A4.	$pV = \dfrac{1}{3}Nm\overline{c^2}$	kinetic theory equation	D6.	$R = \dfrac{\rho l}{A}$	resistance and resistivity
A5.	$E_k = \dfrac{3RT}{2N_A}$	molecular kinetic energy	D7.	$R = R_1 + R_2$	resistors in series
B1.	$F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$	force	D8.	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$	resistors in parallel
B2.	moment = $F \times d$	moment of a force	D9.	$P = IV = I^2R$	power in a circuit
B3.	$E_P = mgh$	gravitational potential energy	D10.	$F = BQ\upsilon\sin\theta$	force on a moving charge in a magnetic field
B4.	$E_K = \dfrac{1}{2}mv^2$	kinetic energy	D11.	$F = BIl\sin\theta$	force on a current-carrying conductor in a magnetic field
B5.	$F = kx$	Hooke's law	D12.	$V = \dfrac{BI}{nQt}$	Hall voltage
B6.	$P = Fv = \dfrac{W}{t}$	mechanical power	D13.	$B = \dfrac{\mu_0 I}{2\pi r}$	magnetic field due to a long straight wire
B7.	$a = \dfrac{\upsilon^2}{r} = \omega^2 r$	centripetal acceleration	D14.	$B = \dfrac{\mu_0 NI}{l}$	magnetic field inside a long solenoid
B8.	$F = \dfrac{Gm_1m_2}{r^2}$	Newton's law of gravitation	D15.	$\varepsilon = N\dfrac{\Delta\Phi}{\Delta t}$	induced e.m.f.
C1.	$\Delta y = \dfrac{\lambda D}{a}$	fringe width in double-slit interference	D16.	$\dfrac{V_s}{V_p} \approx \dfrac{N_s}{N_p}$	ratio of secondary voltage to primary voltage in a transformer
C2.	$d\sin\theta = n\lambda$	diffraction grating equation	E1.	$N = N_0 e^{-kt}$	law of radioactive decay
C3.	$\dfrac{1}{u} + \dfrac{1}{v} = \dfrac{1}{f}$	equation for a single lens	E2.	$t_{\frac{1}{2}} = \dfrac{\ln 2}{k}$	half-life and decay constant
D1.	$F = \dfrac{Q_1Q_2}{4\pi\varepsilon_0 r^2}$	Coulomb's law	E3.	$A = kN$	activity and the number of undecayed nuclei
D2.	$E = \dfrac{Q}{4\pi\varepsilon_0 r^2}$	electric field strength due to a point charge	E4.	$E = mc^2$	mass-energy relationship

Astronomy and Space Science

$U = -\dfrac{GMm}{r}$	gravitational potential energy
$P = \sigma AT^4$	Stefan's law
$\dfrac{\Delta f}{f_o} \approx \dfrac{v}{c}$	Doppler effect

Energy and Energy Use

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

Atomic World

$\dfrac{1}{2}m_e v_{\max}^{\ 2} = hf - \phi$	Einstein's photoelectric equation
$E_n = -\dfrac{13.6}{n^2}$ eV	energy level equation for hydrogen atom
$\lambda = \dfrac{h}{p} = \dfrac{h}{mv}$	de Broglie formula
$\theta \approx \dfrac{1.22\lambda}{d}$	Rayleigh criterion (resolving power)

Medical Physics

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