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**PHYSICS
HIGHER LEVEL
PAPER 1**

Thursday 10 May 2012 (afternoon)

1 hour

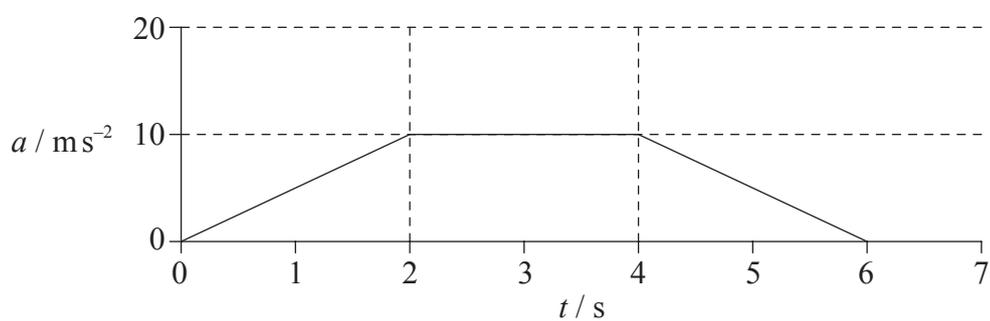
INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A clean copy of the **Physics Data Booklet** is required for this paper.
- The maximum mark for this examination paper is [40 marks].

1. Which of the following is a fundamental SI unit?

- A. Ampere
- B. Joule
- C. Newton
- D. Volt

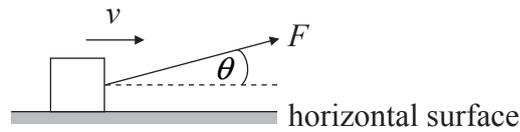
2. The graph shows the acceleration a of an object as time t varies.



What is the magnitude of the change in the velocity of the object between 0 and 3 seconds?

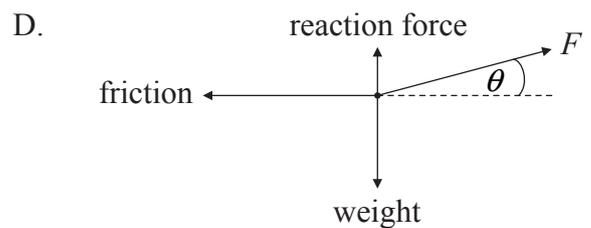
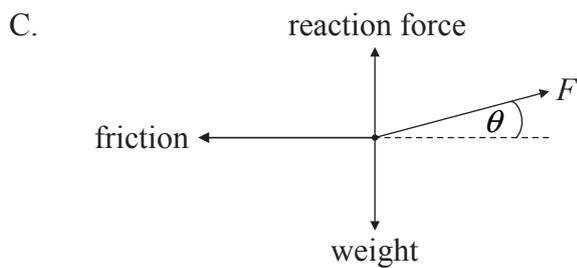
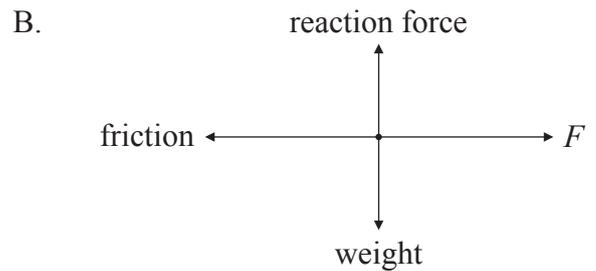
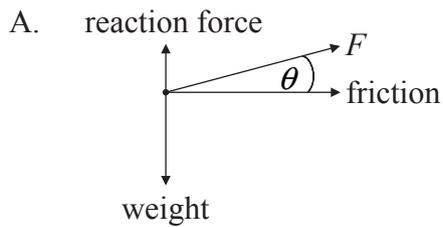
- A. 5 ms^{-1}
- B. 10 ms^{-1}
- C. 20 ms^{-1}
- D. 30 ms^{-1}

3. A force F acts on a block at an angle θ with respect to a horizontal surface.



The block is moving with a constant velocity v along the surface. A resistive force acts on the block.

Which of the following correctly represents the forces acting on the block?



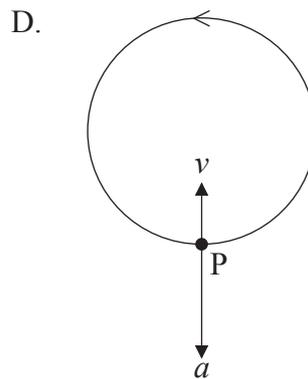
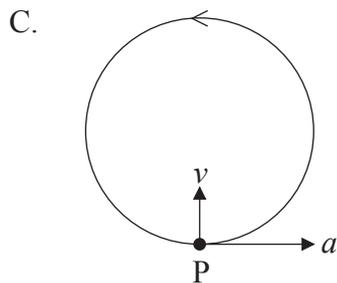
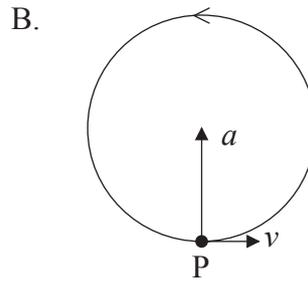
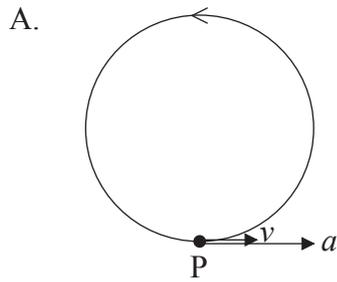
4. A student makes three statements about situations in which no work is done on an object.

- I. The object is moving with uniform circular motion.
- II. A force is applied to the object in the direction of its velocity.
- III. A force is applied to the object in a direction opposite to its motion.

Which of the above statements is/are correct?

- A. I only
- B. I and II only
- C. I and III only
- D. III only

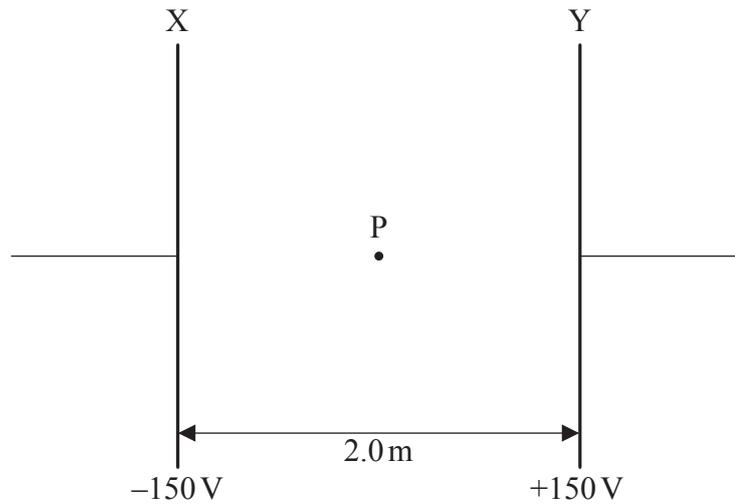
5. Particle P is moving with uniform speed in a horizontal circle. Which of the following shows the correct directions of the acceleration a and the velocity v of P at the position shown?



6. A ball is thrown with velocity u at an angle of 55° above the horizontal. Which of the following is the magnitude of the horizontal component of velocity?

- A. $u \cos 55^\circ$
- B. $u \sin 55^\circ$
- C. u
- D. $u \tan 55^\circ$

7. Two charged parallel metal plates, X and Y, are separated by a distance of 2.0m. X is at a potential of -150 V and Y is at a potential of $+150\text{ V}$.



Point P is midway between X and Y. Which of the following gives the electric field strength at point P?

- A. 150 V m^{-1} to the right
 - B. 150 V m^{-1} to the left
 - C. 300 V m^{-1} to the right
 - D. 300 V m^{-1} to the left
8. A satellite in close-Earth orbit moves to an orbit further from the Earth's surface. Which of the following concerning the speed of the satellite and its gravitational potential energy in the new orbit is correct?

	Speed of the satellite	Gravitational potential energy
A.	increases	decreases
B.	increases	increases
C.	decreases	decreases
D.	decreases	increases

9. Which of the following changes on its own will increase the rate of evaporation of a liquid at constant temperature?
- A. An increase in the surface area of the liquid
 - B. An increase in the total pressure acting on the liquid
 - C. A decrease in the surface area of the liquid
 - D. A decrease in the volume of the liquid
10. Which of the following correctly identifies the properties of the molecules of a substance that determine the substance's internal energy?
- A. The total potential energy and random kinetic energy
 - B. The random kinetic energy
 - C. The total gravitational potential energy and random kinetic energy
 - D. The total potential energy

The following statement refers to question 11 and question 12.

A gas is contained in a thermally insulated cylinder by a freely moving piston. The volume of the gas is increased reversibly by moving the piston.

11. Which term identifies the change of state of the gas?

- A. Isobaric
- B. Isochoric
- C. Isothermal
- D. Adiabatic

12. Which of the following gives the correct entropy change of the gas and the surroundings?

	Entropy change of the gas	Entropy change of the surroundings
A.	decrease	decrease
B.	no change	decrease
C.	decrease	no change
D.	no change	no change

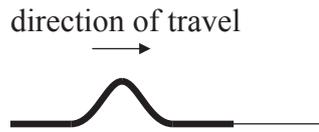
13. Two boxes, X and Y, each contain an ideal gas at the same temperature. Box X has a volume V and contains n moles of the gas at a pressure P_x . Box Y has a volume $5V$ and contains $\frac{n}{3}$ moles of the gas at a pressure P_y .

Which of the following gives the correct value of $\frac{P_x}{P_y}$?

- A. $\frac{1}{15}$
- B. $\frac{3}{5}$
- C. $\frac{5}{3}$
- D. 15
14. A particle is undergoing simple harmonic motion (SHM) in a horizontal plane. The total mechanical energy of the system is E . Which of the following correctly gives the kinetic energy of the particle at the positions of maximum displacement and equilibrium?

	Maximum displacement	Equilibrium
A.	$\frac{1}{2}E$	$\frac{1}{2}E$
B.	0	E
C.	$\frac{1}{2}E$	0
D.	E	0

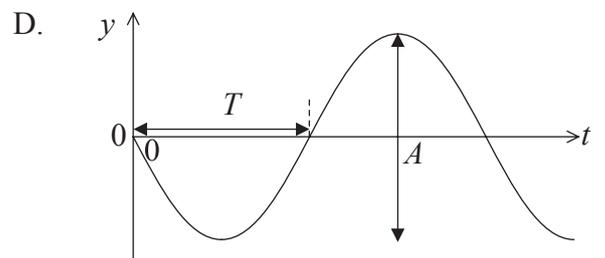
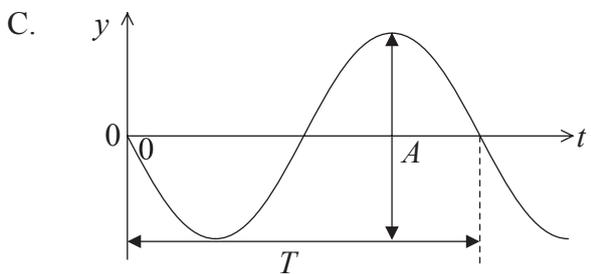
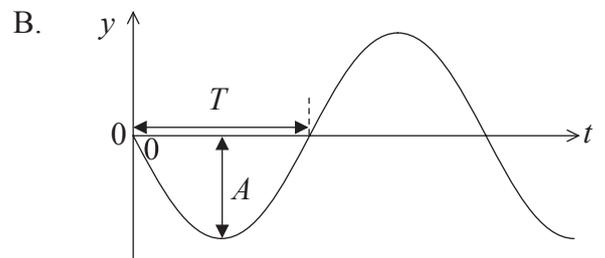
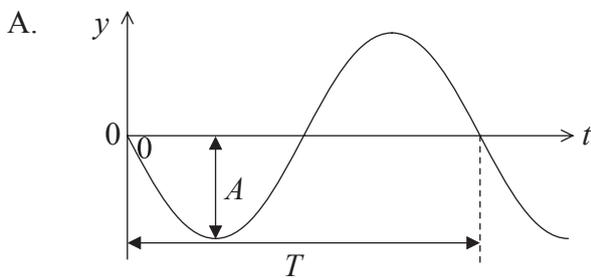
15. A wave pulse is travelling along a dense thick rope which is connected to a less dense thin rope.



Which of the following is correct regarding the reflected and transmitted wave pulses after the wave pulse reaches the connection of the two ropes?

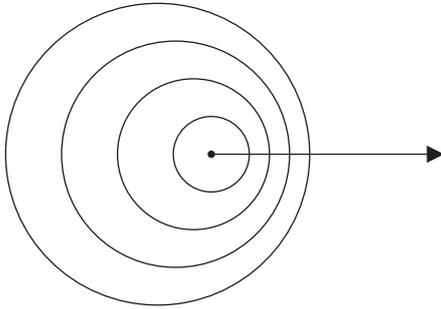
	Reflected pulse	Transmitted pulse
A.	inverted	inverted
B.	not inverted	inverted
C.	inverted	not inverted
D.	not inverted	not inverted

16. The diagrams show the variation with time t of the displacement y of a particle of a medium through which a wave travels. Which diagram correctly shows the period T and amplitude A of the wave?

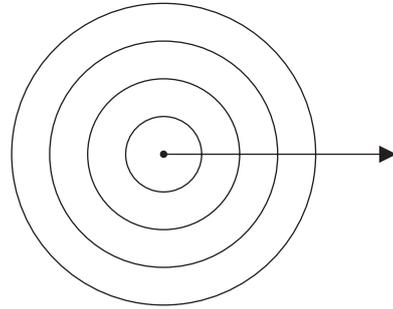


17. A point source of sound is moving to the right at constant speed. The source emits sound waves of constant frequency. The speed of the source is less than the speed of sound. Which diagram correctly shows the wavefronts of the sound?

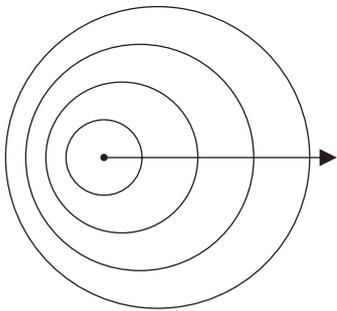
A.



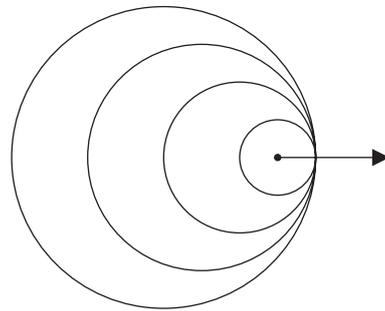
B.



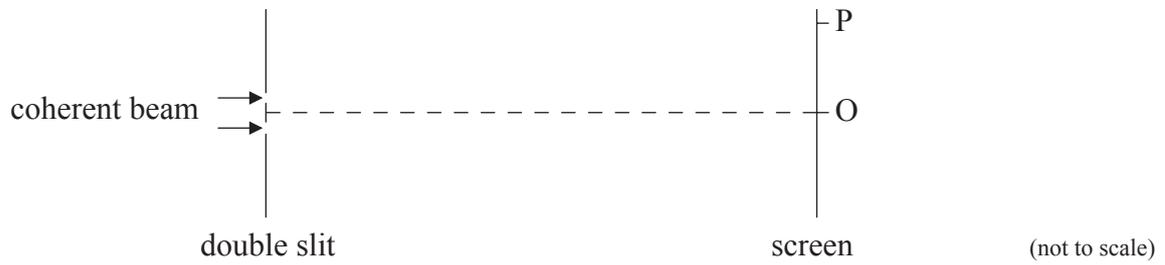
C.



D.



18. A coherent beam of light of wavelength λ is incident on a double slit. The width of the slits is small compared to their separation. An interference pattern is observed on a distant screen. O is the mid point of the screen.

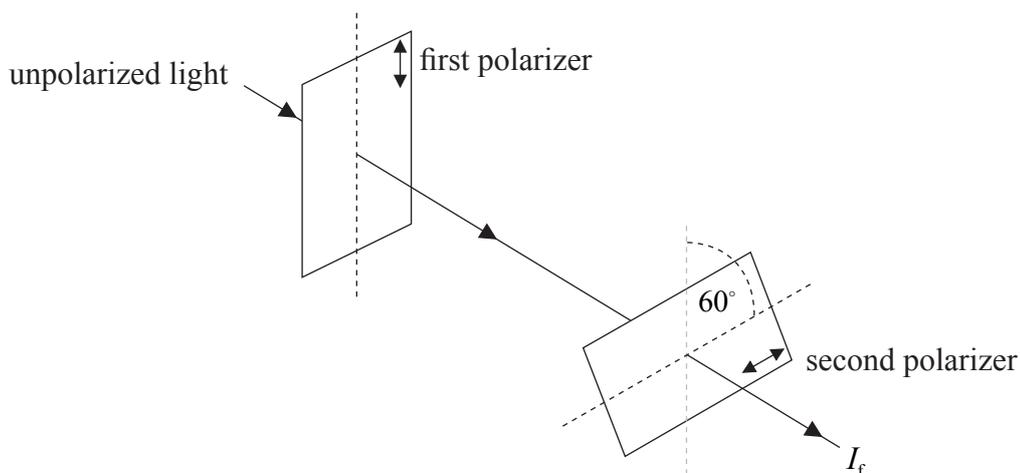


There is a bright fringe at O and a bright fringe at P. Between O and P there are three dark fringes.

Which of the following is the path difference between the light from the two slits arriving at P?

- A. 1.5λ
 - B. 2λ
 - C. 3λ
 - D. 4λ
19. An object to be viewed by a microscope is irradiated with blue light. The reason for using blue light rather than light of a longer wavelength is to increase
- A. diffraction.
 - B. interference.
 - C. resolution.
 - D. magnification.

20. Unpolarized light is incident on a polarizer. The light transmitted by the first polarizer is then incident on a second polarizer. The polarizing axis of the second polarizer is at 60° to that of the first polarizer.



The intensity emerging from the second polarizer is I_f .

Which of the following correctly gives the intensity incident on the first polarizer?

- A. $\frac{I_f}{8}$
- B. $\frac{I_f}{4}$
- C. $4I_f$
- D. $8I_f$
21. A metal wire X with length L and radius r has a resistance R . A wire Y of length $4L$ made from the same material as X has the same resistance R . What is the radius of Y?
- A. $2r$
- B. $4r$
- C. $\frac{r}{2}$
- D. $\frac{r}{4}$

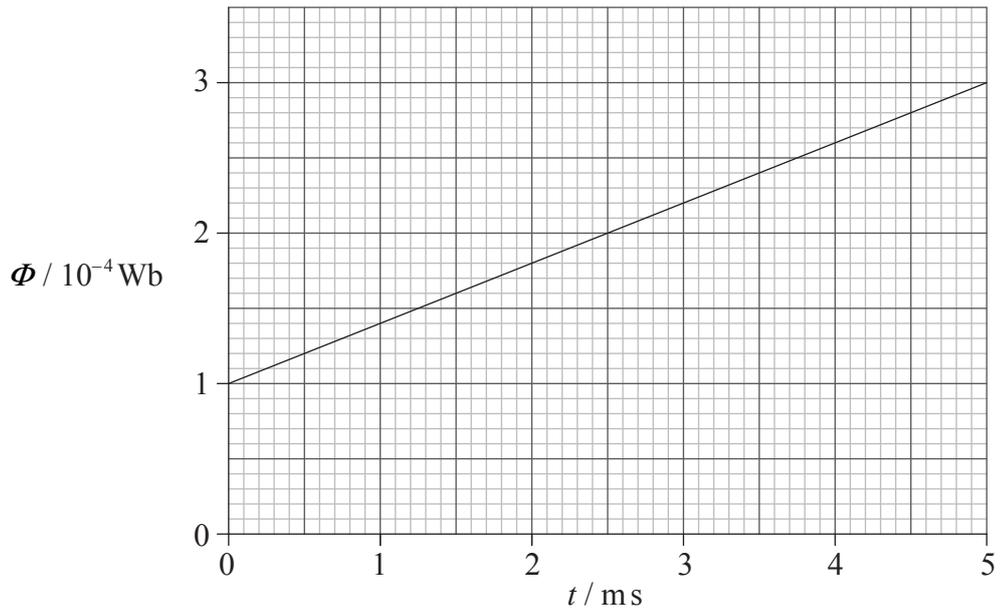
22. Which of the following is the correct way of connecting an ammeter and of connecting a voltmeter in a circuit designed to measure the characteristics of a thermistor?

	Ammeter	Voltmeter
A.	in series with thermistor	in series with thermistor
B.	in parallel with thermistor	in series with thermistor
C.	in series with thermistor	in parallel with thermistor
D.	in parallel with thermistor	in parallel with thermistor

23. Which of the following will **not** give rise to a magnetic field?

- A. A moving electron
- B. A moving neutron
- C. A proton and electron moving away from each other
- D. A proton and electron moving towards each other

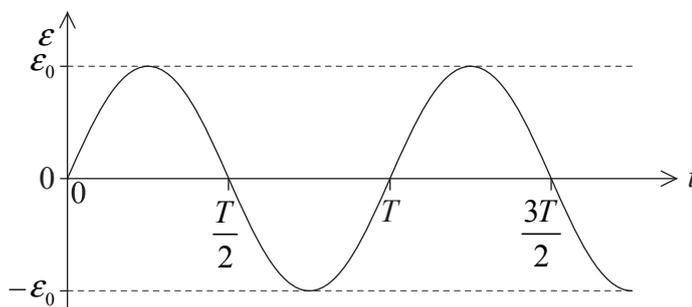
24. The magnetic flux Φ through a coil with 1000 turns varies with time t as shown in the graph.



What is the magnitude of the emf produced in the coil?

- A. 0.04 V
- B. 0.06 V
- C. 40 V
- D. 60 V

25. A coil rotates in a magnetic field. The emf \mathcal{E} produced in the coil varies sinusoidally with time t as shown.



Which of the following correctly gives the rms value of the emf and the frequency of rotation of the coil?

	rms value of emf	Frequency of rotation
A.	$\varepsilon_0\sqrt{2}$	$\frac{1}{T}$
B.	$\frac{\varepsilon_0}{\sqrt{2}}$	$\frac{2}{T}$
C.	$\varepsilon_0\sqrt{2}$	$\frac{2}{T}$
D.	$\frac{\varepsilon_0}{\sqrt{2}}$	$\frac{1}{T}$

26. Which of the following is correct for nuclear fuel in respect of both its energy density and its long-term sustainability?

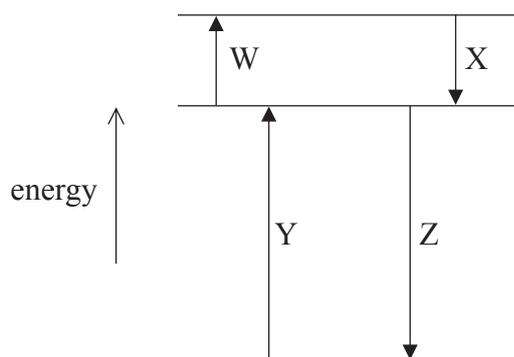
	Energy density	Sustainability
A.	high	renewable
B.	low	renewable
C.	high	non-renewable
D.	low	non-renewable

27. Which of the following is the primary function of the moderator in a nuclear power station?
- A. To control the rate of fission reactions
 - B. To absorb neutrons
 - C. To prevent the power station from becoming unsafe
 - D. To slow down neutrons
28. Nuclear mass values provide evidence for the existence of
- A. isotopes.
 - B. atomic energy levels.
 - C. protons.
 - D. electrons.
29. An electron of mass m_e and a proton of mass m_p are moving with the same kinetic energy at non-relativistic speeds. The de Broglie wavelengths associated with the electron and the proton are λ_e and λ_p respectively.

Which of the following correctly gives the ratio $\frac{\lambda_e}{\lambda_p}$?

- A. $\frac{m_p}{m_e}$
- B. $\frac{m_e}{m_p}$
- C. $\sqrt{\frac{m_p}{m_e}}$
- D. $\sqrt{\frac{m_e}{m_p}}$

30. The diagram shows three energy levels of the hydrogen atom and some of the associated electron transitions between the levels.



Which labelled electron transition gives rise to the photon with the greatest wavelength and which gives rise to the photon with the smallest wavelength?

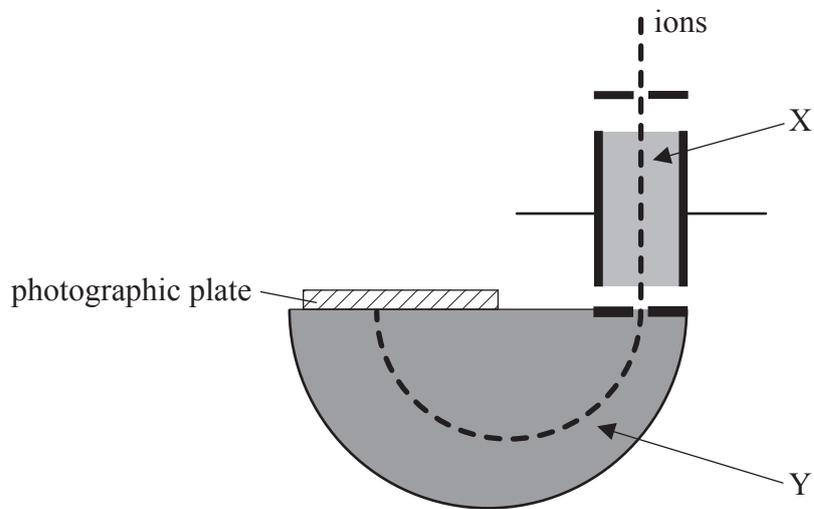
	Greatest wavelength	Smallest wavelength
A.	X	W
B.	Y	Z
C.	X	Z
D.	Y	W

31. The decay constant of a radioactive isotope is 10^{-3} s^{-1} . Which of the following is the probability that a nucleus of the isotope will decay in the next second?

- A. $\frac{1}{1000}$
- B. 1000
- C. $1000 \ln 2$
- D. $\frac{1}{1000 \ln 2}$

32. Which of the following is a correct list of particles upon which the strong nuclear force may act?
- A. protons and neutrons
 - B. protons and electrons
 - C. neutrons and electrons
 - D. protons, neutrons and electrons

33. The diagram shows the Bainbridge mass spectrometer.



Which of the following correctly identifies the fields present in region X and in region Y?

	Region X	Region Y
A.	electric only	magnetic only
B.	electric and magnetic	electric only
C.	electric and magnetic	magnetic only
D.	electric only	electric and magnetic

34. The rate of formation of a non-renewable energy resource is
- A. greater than the rate of consumption of the resource.
 - B. less than the rate of consumption of the resource.
 - C. always equal to zero.
 - D. decreasing as the resource is consumed.
35. The blades of a certain wind turbine X have radius r . The maximum theoretical available wind power for a given wind speed is P . Another similar turbine Y has blades of radius $2r$. What is the best estimate for the maximum theoretical available wind power from turbine Y?
- A. $8P$
 - B. $4P$
 - C. $\frac{P}{4}$
 - D. $\frac{P}{8}$
36. The property of the molecules of greenhouse gases which leads to their ability to absorb infrared radiation is their
- A. resonant frequency.
 - B. speed of rotation.
 - C. total electric charge.
 - D. diameter.

37. Which of the following is the most likely cause of the enhanced greenhouse effect?
- A. Increased volcanic activity
 - B. Deforestation
 - C. Burning of fossil fuels
 - D. Solar flare activity
38. In a charge-coupled device (CCD), the charge developed in the pixel arises mainly from
- A. the migration of electrons due to a temperature gradient.
 - B. a chemical reaction between electrons and the surface.
 - C. the photoelectric release of electrons from the surface.
 - D. transfer of electrons from the power supply.
39. Which of the following correctly defines the magnification of a charge-coupled device (CCD) and the quantum efficiency of a pixel of the CCD?

	Magnification	Quantum efficiency
A.	$\frac{\text{length of image on CCD}}{\text{length of object}}$	$\frac{\text{number of photoelectrons emitted by pixel}}{\text{number of photons incident on pixel}}$
B.	$\frac{\text{length of image on CCD}}{\text{length of object}}$	$\left(\frac{\text{number of photoelectrons emitted by pixel}}{\text{number of photons incident on pixel}} \right)^2$
C.	$\frac{\text{area of image on CCD}}{\text{area of object}}$	$\frac{\text{number of photoelectrons emitted by pixel}}{\text{number of photons incident on pixel}}$
D.	$\frac{\text{area of image on CCD}}{\text{area of object}}$	$\left(\frac{\text{number of photoelectrons emitted by pixel}}{\text{number of photons incident on pixel}} \right)^2$

40. Photoelectrons are emitted from the surface of a metal when light of frequency f is incident on it. Which of the following shows the variation with f of the maximum kinetic energy E_k of the photoelectrons?

