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PHYSICS
STANDARD LEVEL
PAPER 1

Thursday 6 November 2014 (morning)

45 minutes

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 *[30 marks]*.

1. Which of the following is a fundamental unit?

A. Ampere

B. Coulomb

C. Ohm

D. Volt

2. The maximum acceleration a_{max} of an oscillator undergoing simple harmonic motion (SHM) has a percentage uncertainty of 12%. The amplitude x_0 of the oscillation has a percentage uncertainty of 20%. If $k = \sqrt{\frac{a_{max}}{x_0}}$ what is the percentage uncertainty in the constant k?

A. 4%

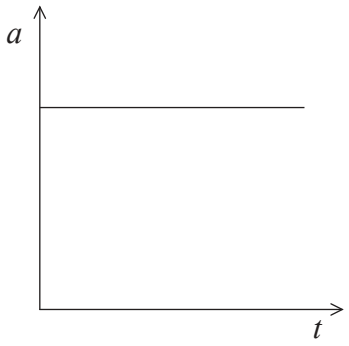
B. 8%

C. 16%

D. 32%

3. An object is dropped from rest above the Earth's surface. Air resistance acts on the object. What is the variation of acceleration a with time t for the object?

A.



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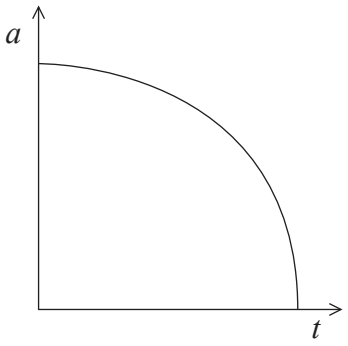

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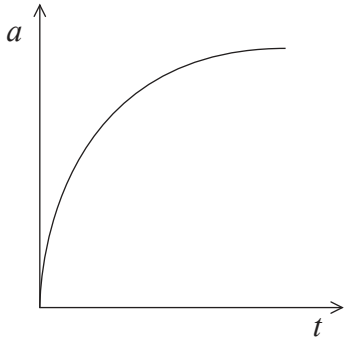

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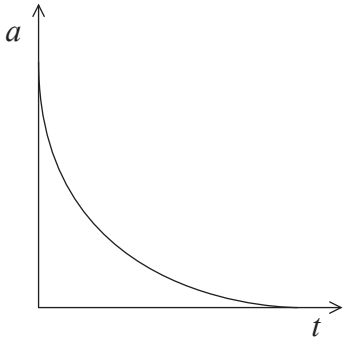


4. Which of the following is a condition for an object to be in translational equilibrium?

A. The object must be moving at constant speed.

B. The velocity of the object in any direction must be zero.

C. The forces acting horizontally on the object must equal the forces acting vertically on the object.

D. The resultant force acting on the object must be zero.

5. An object rotates in a horizontal circle when acted on by a centripetal force F. What is the centripetal force acting on the object when the radius of the circle doubles and the kinetic energy of the object halves?

A. $\frac{F}{4}$

B. $\frac{F}{2}$

C. F

D. $4F$

6. No external forces act on a given system during an inelastic collision. For this system, which is correct about the conservation of kinetic energy and the conservation of linear momentum?

	Kinetic energy	**Linear momentum**
A.	must be conserved	may be conserved
B.	must be conserved	must be conserved
C.	is not conserved	may be conserved
D.	is not conserved	must be conserved

7. An object of mass m_1 has a kinetic energy E_1. Another object has a mass m_2 and kinetic energy E_2. The objects have the same momentum. What is the ratio $\frac{E_1}{E_2}$?

A. 1

B. $\sqrt{\frac{m_2}{m_1}}$

C. $\frac{m_2}{m_1}$

D. $\left(\frac{m_2}{m_1}\right)^2$

8. A metal sphere is at rest on a bench. According to Newton's third law of motion, what is a possible action-reaction pair for this situation?

	Action	Reaction
A.	downwards gravitational force of Earth on the sphere	upwards gravitational force of the sphere on Earth
B.	upwards gravitational force of Earth on the sphere	downwards gravitational force of the sphere on Earth
C.	upwards electrostatic force acting on the sphere due to the atoms in the bench surface	upwards gravitational force of the sphere on Earth
D.	upwards electrostatic force acting on the sphere due to the atoms in the bench surface	downwards gravitational force of the sphere on Earth

9. Two objects are in thermal contact, initially at different temperatures. Which of the following determines the transfer of thermal energy between the objects?

I. The mass of each object

II. The thermal capacity of the objects

III. The temperature of the objects

A. I only

B. I and II only

C. II and III only

D. III only

10. An electrical heating coil of power P is used to transfer thermal energy to a body of mass m. In a time t the body changes temperature by $\Delta\theta$. What is the thermal capacity of the body?

A. $\frac{Pt}{m\Delta\theta}$

B. $\frac{P}{tm\Delta\theta}$

C. $\frac{Pt}{\Delta\theta}$

D. $\frac{P}{t\Delta\theta}$

11. The following can be determined for a solid substance.

I. The average kinetic energy $E_{K_{ave}}$ of the molecules

II. The total kinetic energy $E_{K_{tot}}$ of the molecules

III. The total potential energy $E_{P_{tot}}$ of the molecules

Which is/are equal to the internal energy of this solid substance?

A. I only

B. I and III only

C. II only

D. II and III only

12. A high solid wall separates two gardens X and Y. Music from a loudspeaker in X can be heard in Y even though X cannot be seen from Y. The music can be heard in Y due to

A. absorption.

B. diffraction.

C. reflection.

D. refraction.

13. X and Y are two sources of waves with identical amplitudes and frequencies. Waves from X and Y interfere constructively at a detector after travelling the same distance from source to detector.

At the detector, the ratio $\frac{\text{intensity of the resultant of the two waves}}{\text{intensity of one wave alone}}$ is

A. $\frac{1}{2}$.

B. 1.

C. 2.

D. 4.

14. The natural frequency of vibration of a system

A. is the frequency at which it oscillates when it is driven by another system.

B. is the frequency at which it oscillates when it is **not** driven by another system.

C. depends on the damping in the system.

D. depends on the amplitude of the oscillation of the system.

15. A particle undergoes simple harmonic motion (SHM) of maximum kinetic energy E_{max} and amplitude x_0. The particle is released from rest at its maximum displacement amplitude.

What is the change in the kinetic energy when the particle has travelled a distance of $\frac{x_0}{3}$?

A. $\frac{E_{max}}{9}$

B. $\frac{4E_{max}}{9}$

C. $\frac{5E_{max}}{9}$

D. $\frac{8E_{max}}{9}$

16. A cylindrical resistor of volume V and length l has resistance R. The resistor has a uniform circular cross-section. What is the resistivity of the material from which the resistor is made?

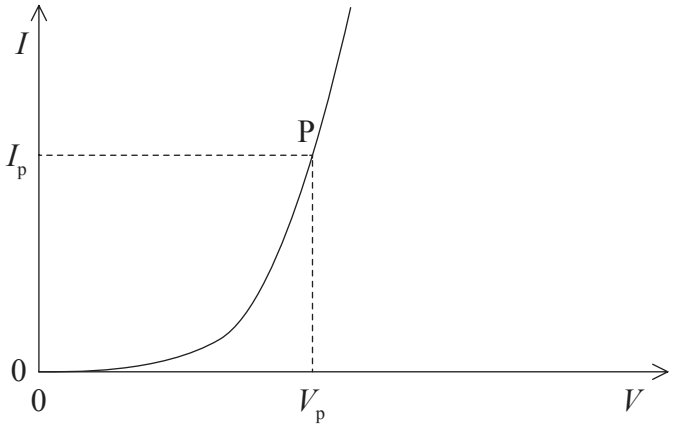
A. $\frac{V}{Rl^2}$

B. $\frac{V^2R}{l}$

C. $\frac{VR}{l^2}$

D. $\frac{V^2}{Rl}$

17. The graph shows the variation of current I with the potential difference V in a device.



What is the resistance of the device at point P?

A. $\frac{I_p}{V_p}$

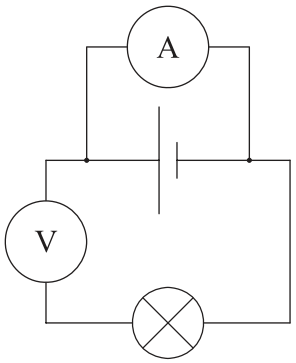
B. $\frac{V_p}{I_p}$

C. Gradient of the graph at P

D. $\frac{1}{\text{Gradient of the graph at P}}$

18. A lamp is connected to an electric cell and it lights at its working voltage. The lamp is then connected to the same cell in a circuit with an ideal ammeter and an ideal voltmeter. Which circuit allows the lamp to light at the original brightness?

A.



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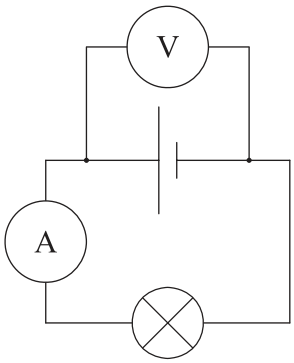

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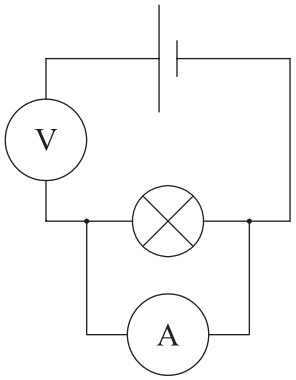

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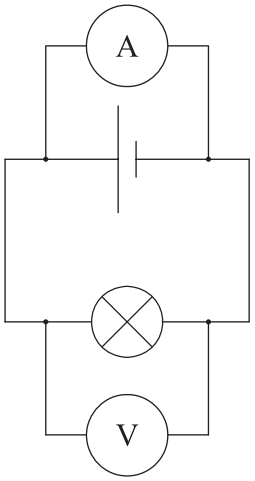


19. What is the definition of gravitational field strength at a point?

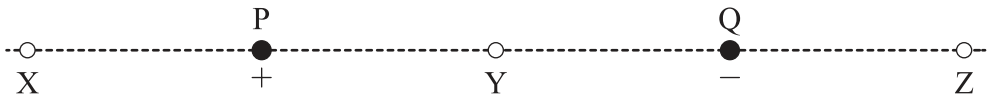
A. Force acting per unit mass on a small mass placed at the point.

B. Work done per unit mass on any mass moved to the point.

C. Force acting on a small mass placed at the point.

D. Work done on any mass moved to the point.

20. A positive point charge P and a negative point charge Q of equal magnitude are held at fixed positions. Y is midway between P and Q.

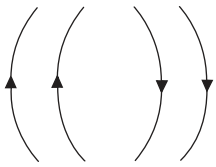


Which of the following gives the direction of the electric field due to the charges at X, Y and Z?

	X	Y	Z
A.	to right	to left	to right
B.	to right	to right	to left
C.	to left	to right	to right
D.	to left	to right	to left

21. What field pattern can be produced by two point charges?

A.



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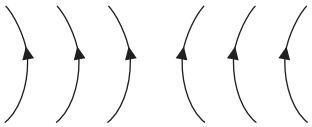

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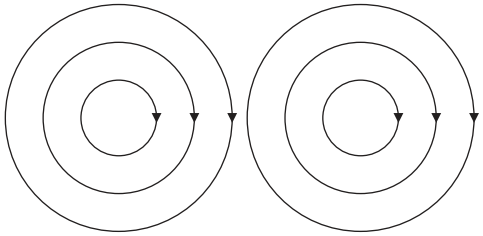

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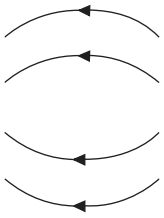


22. Which describes the ionizing ability and the penetrating ability of alpha particles?

	Ionizing ability	Penetrating ability
A.	low	high
B.	high	low
C.	low	low
D.	high	high

23. A student suggests the following nuclear reaction between deuterium ${}^{2}_{1}\mathrm{H}$ and tritium ${}^{3}_{1}\mathrm{H}$

$$ {}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow n\mathrm{X} + m\mathrm{Y} $$

where n and m are integers. What are X and Y?

	X	Y
A.	electron	neutron
B.	electron	proton
C.	alpha particle	neutron
D.	alpha particle	proton

24. In a neutral atom there are n_e electrons, n_p protons and n_n neutrons. What is the mass number of the nuclide?

A. $n_p + n_e + n_n$

B. $n_p + n_n$

C. $n_n + n_p - n_e$

D. $n_n - n_e$

25. Which of the following is **true** when thermal energy is converted into work in a single process and a cyclical process?

	Single process	Cyclical process
A.	complete conversion of thermal energy into work can occur	energy must be transferred from the system
B.	complete conversion of thermal energy into work can never occur	energy must be transferred from the system
C.	complete conversion of thermal energy into work can occur	energy need not be transferred from the system
D.	complete conversion of thermal energy into work can never occur	energy need not be transferred from the system

26. What is increased in a sample of uranium ore when nuclear fuel is enriched?

A. $\frac{\text{Number of U-238 atoms}}{\text{Number of U-235 atoms}}$

B. $\frac{\text{Number of U-239 atoms}}{\text{Number of U-238 atoms}}$

C. $\frac{\text{Number of U-235 atoms}}{\text{Number of U-238 atoms}}$

D. $\frac{\text{Number of U-238 atoms}}{\text{Number of U-239 atoms}}$

27. What is the combination of processes by which a nucleus of plutonium-239 (^{239}Pu) is formed from a nucleus of uranium-238 (^{238}U)?

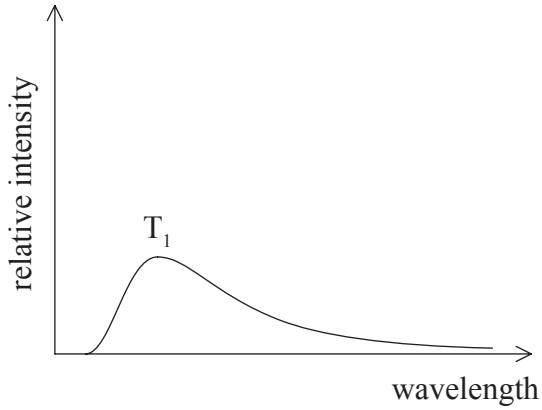
A. nuclear fission + beta emission

B. nuclear fusion + beta emission

C. electron capture + beta emission

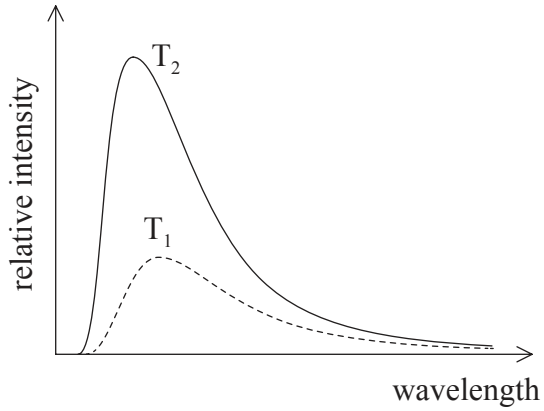
D. neutron capture + beta emission

28. The graph shows the emission spectrum for a black body at absolute temperature T_1.



Which graph shows the emission spectrum for the same black body at an absolute temperature T_2 where $T_2 > T_1$? The original graph is shown as a dotted line.

A.



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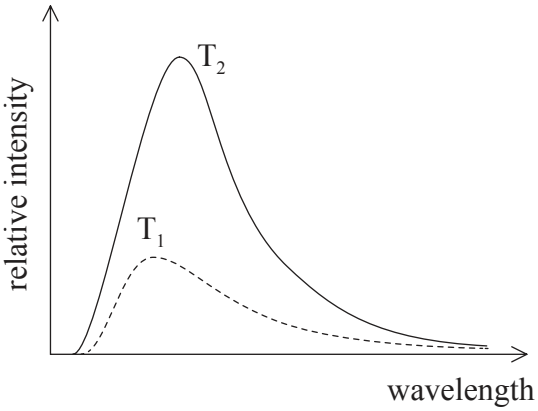

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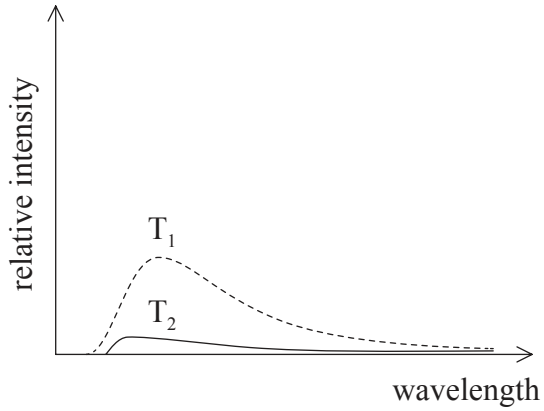

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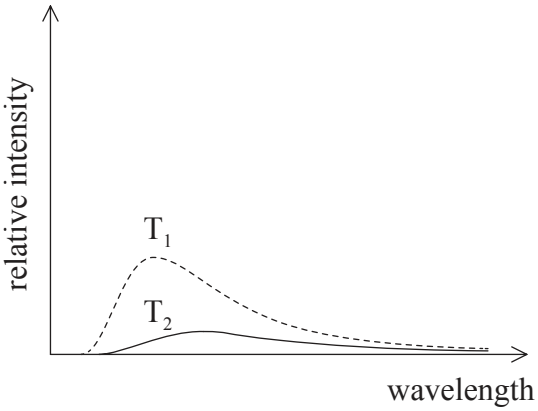

29. What is the unit for surface heat capacity?

A. $\mathrm{N\,m^{-2}\,K^{-1}}$

B. $\mathrm{kg\,m\,s^{-2}\,K^{-1}}$

C. $\mathrm{kg\,s^{-2}\,K^{-1}}$

D. $\mathrm{N\,m^{-3}\,K^{-1}}$

30. The coefficient of volume expansion for sea water is γ. What is the fractional change in the depth of the ocean when its temperature changes by 1 K and its area remains constant?

A. $\frac{\gamma}{3}$

B. γ

C. 3γ

D. $\sqrt[3]{\gamma}$