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PHYSICS
STANDARD LEVEL
PAPER 1

Monday 10 May 2010 (afternoon)

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.

1. The current in a resistor is measured as 2.00 A ± 0.02 A. Which of the following correctly identifies the absolute uncertainty and the percentage uncertainty in the current?

	Absolute uncertainty	Percentage uncertainty
A.	±0.02 A	±1 %
B.	±0.01 A	±0.5 %
C.	±0.02 A	±0.01 %
D.	±0.01 A	±0.005 %

2. Which of the following lists **only** two vector quantities?

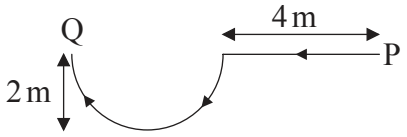
A. mass, energy, work

B. momentum, work, speed

C. weight, force, acceleration

D. momentum, energy, displacement

3. Samantha walks along a horizontal path in the direction shown. The curved part of the path is a semi-circle.



The magnitude of her displacement from point P to point Q is approximately

A. 2 m.

B. 4 m.

C. 6 m.

D. 8 m.

4. Which of the following may be determined from a speed-time graph?

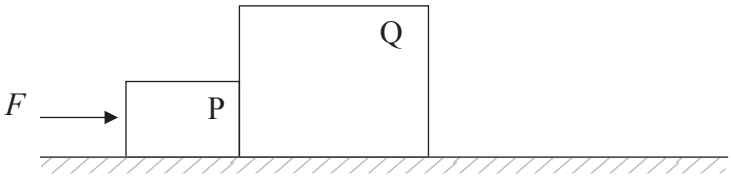
A. Displacement

B. Distance

C. Power

D. Force

5. Stephen pushes two boxes P and Q, that stay in contact, along a rough table, with a force F of 30 N. Box P has a mass of 2.0 kg and box Q has a mass of 4.0 kg. Both boxes move with constant speed.



The resultant force on box Q is

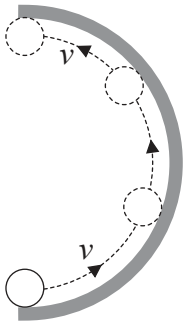
A. 0 N.

B. 5.0 N.

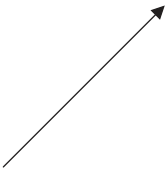
C. 15 N.

D. 30 N.

6. A ball moves along the inside of a horizontal semi-circular ring as shown. The diagram is a view from above.

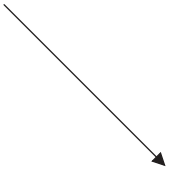


Which arrow represents the direction of the average force on the ball?

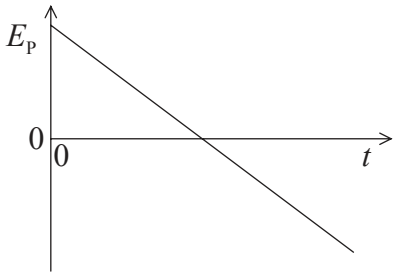
A. 

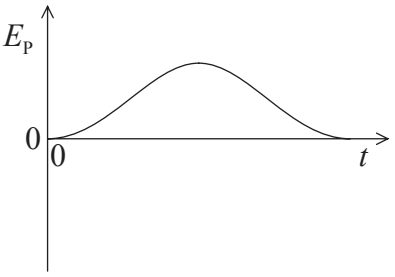
B.

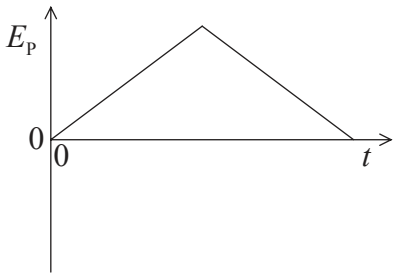
C.

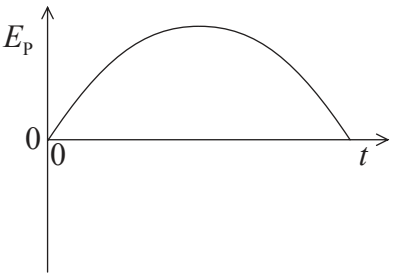
D. 

7. A ball is thrown vertically upwards and comes down again. Air resistance is negligible. Which of the following graphs shows how the gravitational potential energy E_P varies with time t?

A. 

B. 

C. 

D. 

8. A pump extracts water from a well of depth h at a constant rate of R $\text{kg}\,\text{s}^{-1}$. What is the power required to raise the water?

A. $\frac{R}{gh}$

B. Rgh

C. $\frac{Rg}{h}$

D. $\frac{hg}{R}$

9. A box that is at rest with respect to horizontal ground contains a fixed quantity of an ideal gas. The internal energy of the gas is U and its temperature is T. The box is now made to move at constant speed with respect to the ground. Which of the following gives the change, if any, in the internal energy and the temperature of the gas after the box has been moving for some time?

	Internal energy	Temperature
A.	no change	no change
B.	no change	increase
C.	increase	no change
D.	increase	increase

10. Object P has a mass m_P and specific heat capacity c_P. Object Q has a mass m_Q and specific heat capacity c_Q. The temperature of each object increases by the same amount. Which of the following gives the ratio

$$\frac{\text{thermal energy transferred to object P}}{\text{thermal energy transferred to object Q}}?$$

A. $\frac{m_P c_Q}{m_Q c_P}$

B. $\frac{m_P c_P}{m_Q c_Q}$

C. $\frac{m_Q c_Q}{m_P c_P}$

D. $\frac{m_Q c_P}{m_P c_Q}$

11. For two objects to be in thermal equilibrium they must

A. be in contact with each other.

B. radiate equal amounts of power.

C. have the same thermal capacity.

D. be at the same temperature.

12. The shock absorbers of a car, in good working condition, ensure that the vertical oscillations of the car are

A. undamped.

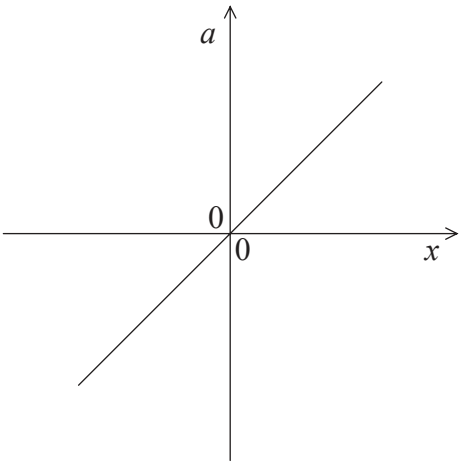
B. lightly damped.

C. moderately damped.

D. critically damped.

13. The graphs show how the acceleration a of four different particles varies with their displacement x. Which of the particles is executing simple harmonic motion?

A.



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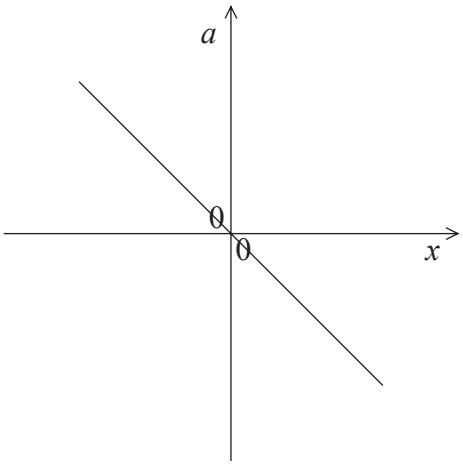
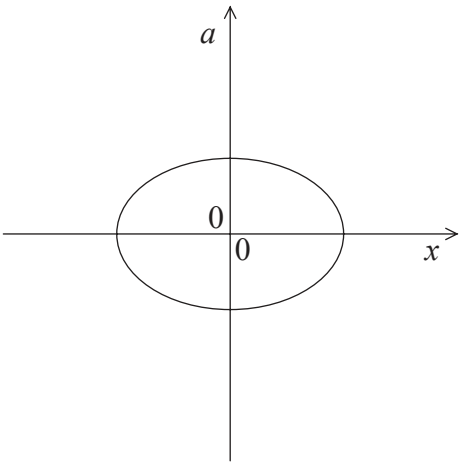
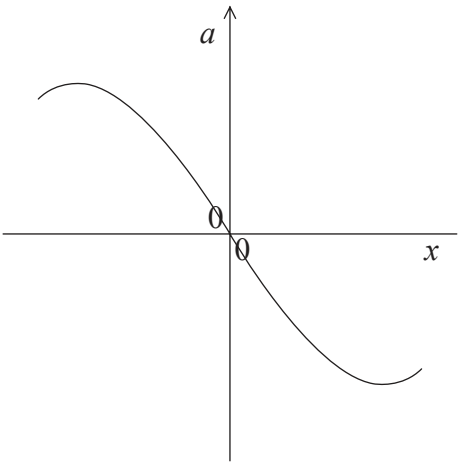


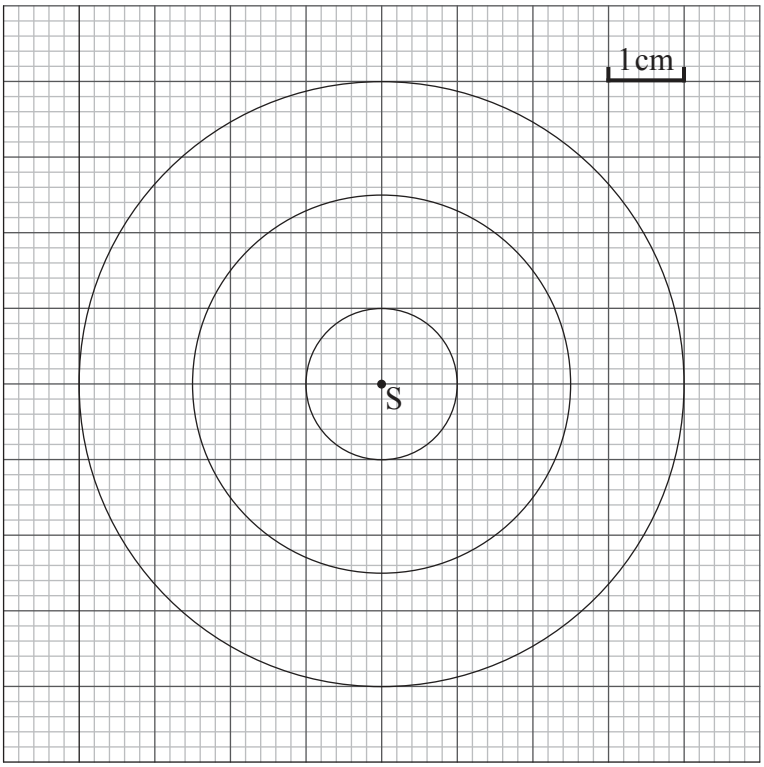
C.



D.



14. The diagram below is a snapshot of wave fronts of circular waves emitted by a point source S at the surface of water. The source vibrates at a frequency $f = 10.0\,\text{Hz}$.



The speed of the wave front is

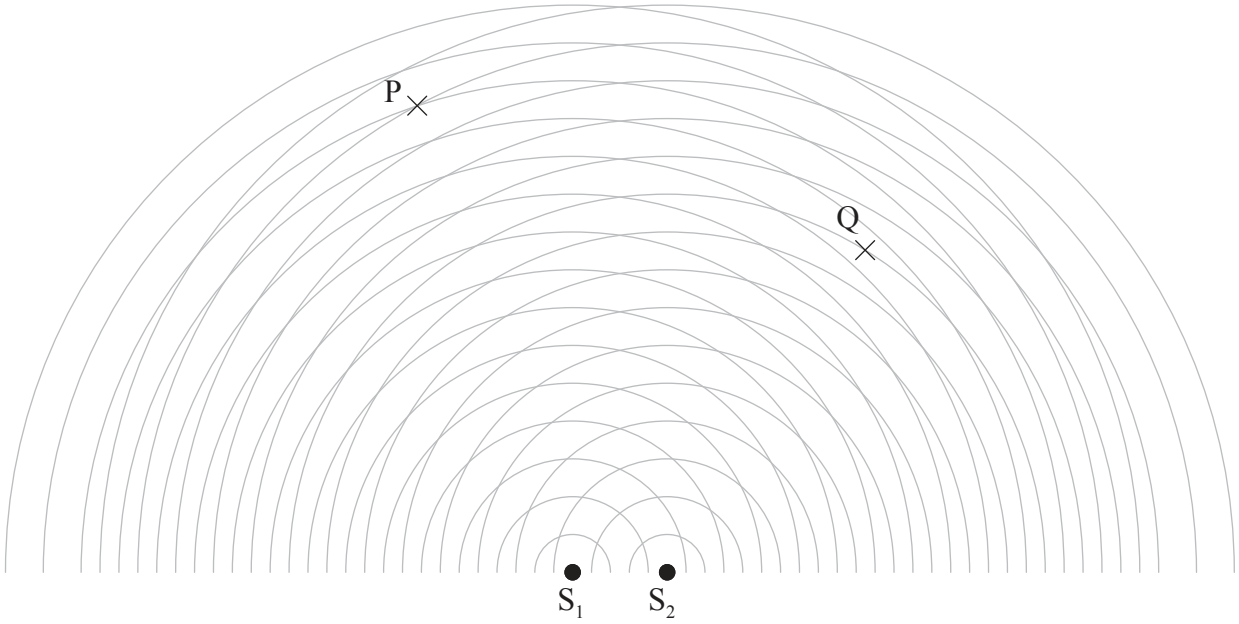
A. $0.15\,\text{cm}\,\text{s}^{-1}$.

B. $1.5\,\text{cm}\,\text{s}^{-1}$.

C. $15\,\text{cm}\,\text{s}^{-1}$.

D. $30\,\text{cm}\,\text{s}^{-1}$.

15. Two coherent point sources S_1 and S_2 emit spherical waves.



Which of the following best describes the intensity of the waves at P and Q?

	P	Q
A.	maximum	minimum
B.	minimum	maximum
C.	maximum	maximum
D.	minimum	minimum

16. An alpha particle is accelerated through a potential difference of 10 kV. Its gain in kinetic energy is

A. 10 eV.

B. 20 eV.

C. 10 keV.

D. 20 keV.

17. A copper wire, of electric resistance R, has a length L and a cross-section area S. Another copper wire has a length $2L$ and a cross-section area of $\frac{S}{2}$. Which of the following is the resistance of this wire?

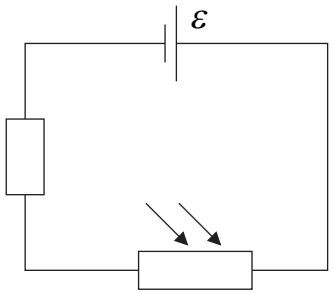
A. $\frac{R}{4}$

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

C. $2R$

D. $4R$

18. The circuit shows a light-dependent resistor (LDR) in series with a resistor and a cell. The emf of the cell is ε. The internal resistance of the cell is negligible.



When light shines on the LDR, the potential difference across the resistor will

A. stay the same.

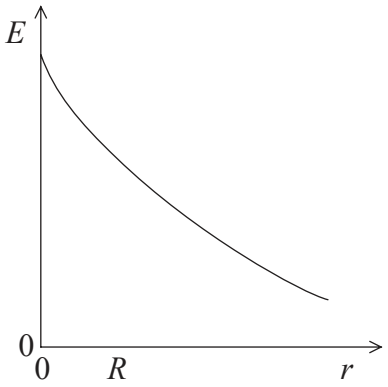
B. decrease.

C. increase but always be less than ε.

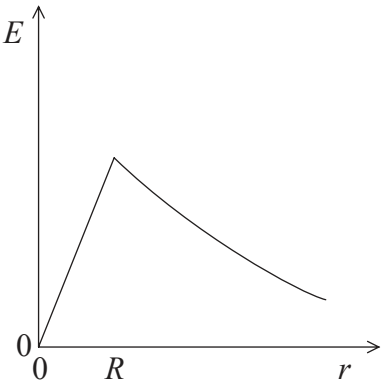
D. increase and exceed ε.

19. The radius of a charged spherical conductor is R. Which of the following graphs best shows how the magnitude of the electrical field strength E varies with distance r from the centre of the sphere?

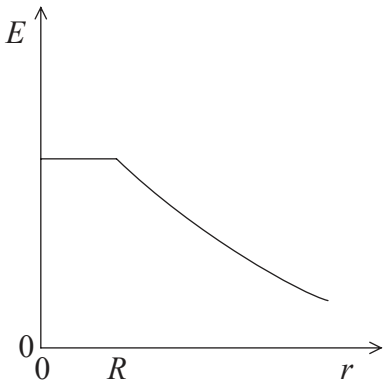
A.



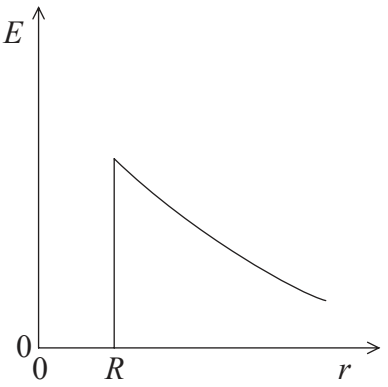
B.



C.



D.



20. Which of the following gives the acceleration of an electron of electric charge e and mass m in a uniform electric field of strength E?

A. E

B. Ee

C. $\frac{Ee}{m}$

D. $\frac{m}{Ee}$

21. A particle, of mass m and charge q, moves with velocity v perpendicularly to a magnetic field. The magnitude of the magnetic force acting on the particle at a particular point is F. Which of the following gives the magnitude of the magnetic field strength at that point?

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

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

C. $\frac{F}{v}$

D. $\frac{F}{qv}$

22. Which of the following decay sequences would result in the daughter nucleus having the same proton number as the parent nucleus?

A. Alpha followed by gamma

B. Beta (β^-) followed by gamma

C. Alpha followed by beta (β^-) followed by beta (β^-)

D. Beta (β^-) followed by gamma followed by gamma

23. The difference between the mass of a ${}^{12}_{6}\mathrm{C}$ nucleus and the sum of the masses of the individual nucleons is 0.1 u. Which of the following is approximately the binding energy of the nucleus?

A. 90 MeV

B. 90 $\mathrm{MeV\,c^{-2}}$

C. 8 MeV

D. 8 $\mathrm{MeV\,c^{-2}}$

24. The process by which a heavy nucleus splits into two lighter nuclei is known as

A. fission.

B. fusion.

C. radioactive decay.

D. artificial (induced) transmutation.

25. Which of the following correctly shows a renewable and a non-renewable source of energy?

	Renewable	Non-renewable
A.	oil	geothermal
B.	wind	biofuels
C.	ocean waves	nuclear
D.	natural gas	coal

26. Critical mass refers to the amount of fissile material that

A. will allow fission to be sustained.

B. is equivalent to 235 g of uranium.

C. will produce a growing chain reaction.

D. is the minimum mass necessary for fission to take place.

27. The annual variations of solar power incident per unit area at a particular point on the Earth's surface is mainly due to the change in the

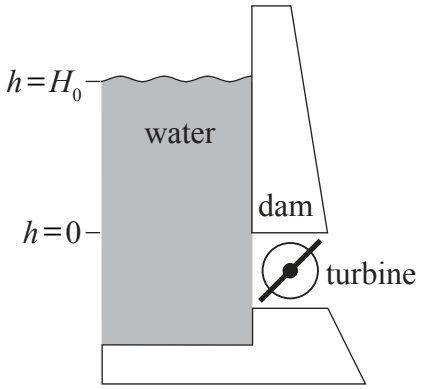
A. distance between the Earth and the Sun.

B. angle at which the solar rays hit the surface of the Earth.

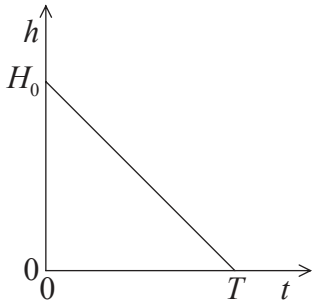
C. average albedo of the Earth.

D. average cloud cover of the Earth.

28. The water in a reservoir behind a dam drops from an initial height H_0 above a turbine to produce hydroelectricity. At time $t = T$, $h = 0$.



The graph shows the variation with time t of the height h of the water above the turbine.



Which of the following is a measure of the maximum theoretical electric power available?

A. H_0 and the slope of the graph

B. T and the slope of the graph

C. T and the area under the graph

D. H_0 and the area under the graph

29. Each square metre of the Sun's surface emits S joules per second. The radius of the Sun is r, and the Sun is at a mean distance R from the Earth. Which of the following gives the solar power incident per unit area of the top layer of the Earth's atmosphere?

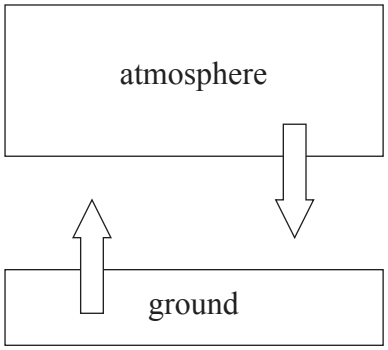
A. $\left(\frac{r}{R}\right)S$

B. $\left(\frac{r}{R}\right)^2 S$

C. $\left(\frac{R}{r}\right)S$

D. $\left(\frac{R}{r}\right)^2 S$

30. The diagram shows a simple climate model for Earth. The temperature of the ground is T_g and is assumed to radiate as a black body. The temperature of the atmosphere is T_a and has an emissivity ε.



In the model, the intensity radiated from the ground equals the intensity radiated from the atmosphere towards the ground. What is the ratio $\frac{T_g}{T_a}$?

A. ε^4

B. ε

C. $\varepsilon^{\frac{1}{4}}$

D. 1