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**PHYSICS**  
**STANDARD LEVEL**  
**PAPER 1**

Monday 6 May 2013 (morning)

45 minutes

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INSTRUCTIONS TO CANDIDATES

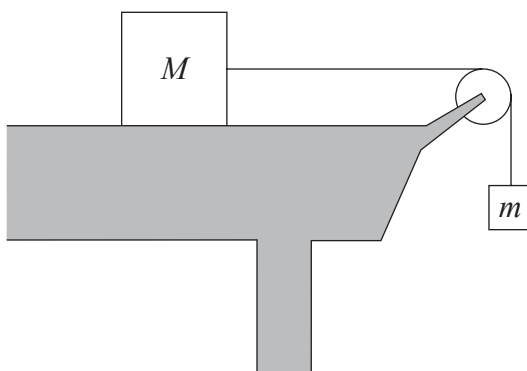
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A clean copy of the **Physics Data Booklet** is required for this paper.
- The maximum mark for this examination paper is [30 marks].

1. The length of the side of a cube is  $10.0 \pm 0.3$  cm. What is the uncertainty in the volume of the cube?
  - A.  $\pm 0.027$  cm<sup>3</sup>
  - B.  $\pm 2.7$  cm<sup>3</sup>
  - C.  $\pm 9.0$  cm<sup>3</sup>
  - D.  $\pm 90$  cm<sup>3</sup>
  
2. Which of the following lists three vector quantities?
  - A. momentum, electric field strength, displacement
  - B. momentum, displacement, pressure
  - C. pressure, electric current, displacement
  - D. electric current, electric field strength, impulse
  
3. An object, initially at rest, travels a distance  $d$  in a time  $t$  at a constant acceleration. What is the time taken for the object to travel  $16d$  from rest at the same acceleration?
  - A.  $16t$
  - B.  $8t$
  - C.  $4t$
  - D.  $2t$

4. An object is released above the surface of Earth. Which of the following correctly describes the speed and acceleration before it reaches terminal speed?

	Speed	Acceleration
A.	increases	remains constant
B.	increases	decreases
C.	remains constant	remains constant
D.	remains constant	decreases

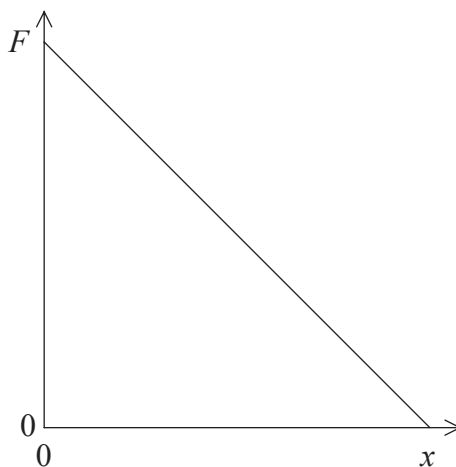
5. An object of mass  $m$  is connected via a frictionless pulley to an object of mass  $M$ , where  $M > m$ .  $M$  rests on a horizontal frictionless surface.



What is the acceleration of the system?

- A.  $\frac{mg}{(M + m)}$
- B.  $\frac{(M + m)g}{m}$
- C.  $\frac{gm}{M}$
- D. Zero

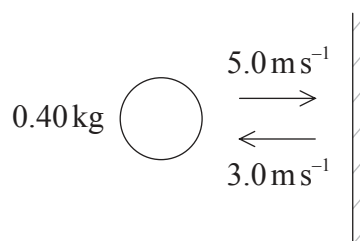
6. The graph shows the variation with distance  $x$  of the magnitude of the net force  $F$  acting on a body initially at rest.



Which of the following describes how the kinetic energy and the acceleration of the body change with distance?

	<b>Kinetic energy</b>	<b>Acceleration</b>
A.	decrease	decrease
B.	decrease	increase
C.	increase	decrease
D.	increase	increase

7. A ball of mass  $0.40\text{ kg}$  travels horizontally and strikes a vertical wall with a speed of  $5.0\text{ m s}^{-1}$ . It rebounds horizontally with a speed of  $3.0\text{ m s}^{-1}$ . The ball is in contact with the wall for a time of  $0.20\text{ s}$ .



What is the average magnitude of the force exerted by the ball on the wall?

- A.  $0.16\text{ N}$
  - B.  $0.64\text{ N}$
  - C.  $4\text{ N}$
  - D.  $16\text{ N}$
8. A car on a road follows a horizontal circular path at constant speed. Which of the following correctly identifies the origin and the direction of the net force on the car?

	<b>Origin</b>	<b>Direction</b>
A.	car engine	toward centre of circle
B.	car engine	away from centre of circle
C.	friction between car tyres and road	away from centre of circle
D.	friction between car tyres and road	toward centre of circle

9. The temperature of an object is  $-153^{\circ}\text{C}$ . Its temperature is raised to  $273^{\circ}\text{C}$ . What is the temperature change of the object?
- A. 699 K  
B. 426 K  
C. 153 K  
D. 120 K

10. Two ideal gases X and Y are at the same temperature. The mass of the molecules of gas X is twice the mass of the molecules of gas Y.

What is the ratio  $\frac{\text{average speed of molecules of gas X}}{\text{average speed of molecules of gas Y}}$ ?

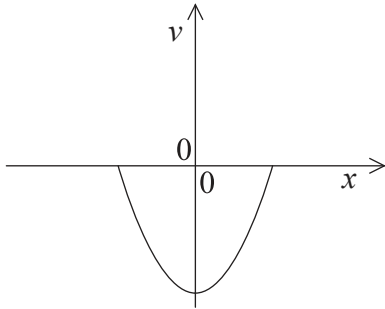
- A.  $\frac{1}{2}$   
B.  $\frac{1}{\sqrt{2}}$   
C.  $\sqrt{2}$   
D. 2
11. A sample contains 4 g of helium and 20 g of neon. The mass number of helium is 4 and the mass number of neon is 20.

What is the ratio  $\frac{\text{number of atoms of neon}}{\text{number of atoms of helium}}$ ?

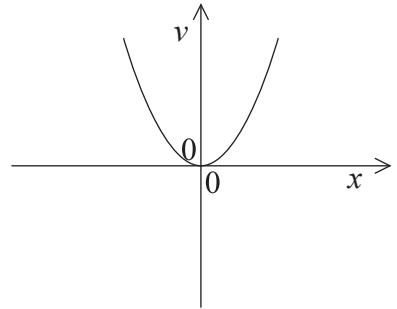
- A. 0.2  
B. 1  
C. 5  
D. 80

12. Which graph shows how velocity  $v$  varies with displacement  $x$  of a system moving with simple harmonic motion?

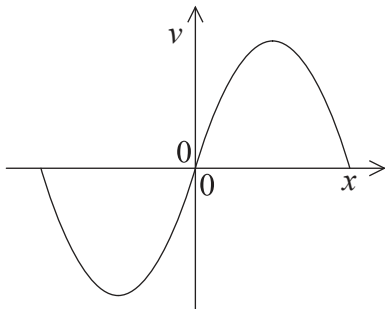
A.



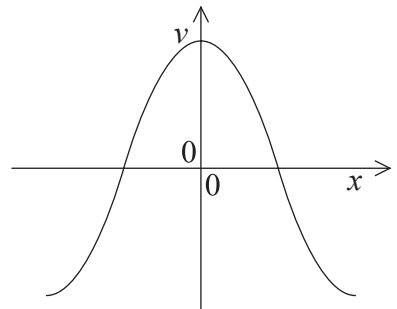
B.



C.



D.



13. An object undergoes simple harmonic motion with time period  $T$  and amplitude 0.5 m. At time  $t=0$  s the displacement of the object is a maximum.

What is the displacement of the object at time  $t = \frac{3T}{4}$ ?

- A. -0.50 m
- B. 0.50 m
- C. 0.25 m
- D. 0 m

14. Light of wavelength 600 nm travels from air to glass at normal incidence. The refractive index of the glass is 1.5. The speed of light in air is  $c$ . Which of the following correctly identifies the speed of the waves and their wavelength in the glass?

	Speed	Wavelength
A.	$\frac{2c}{3}$	900 nm
B.	$c$	900 nm
C.	$c$	400 nm
D.	$\frac{2c}{3}$	400 nm

15. Which of the following correctly describes the direction of a ray drawn relative to a wavefront for longitudinal and transverse waves?

	Longitudinal wave	Transverse wave
A.	parallel	parallel
B.	parallel	perpendicular
C.	perpendicular	parallel
D.	perpendicular	perpendicular

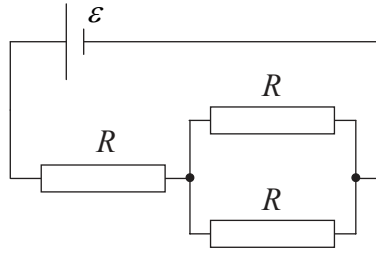
16. A copper wire with length  $L$  and radius  $r$  has a resistance  $R$ .

What is the radius of a copper wire with length  $\frac{L}{2}$  and resistance  $R$ ?

- A.  $2r$
- B.  $\sqrt{2}r$
- C.  $\frac{r}{\sqrt{2}}$
- D.  $\frac{r}{2}$



17. An electric circuit consists of three identical resistors of resistance  $R$  connected to a cell of emf  $\varepsilon$  and negligible internal resistance.



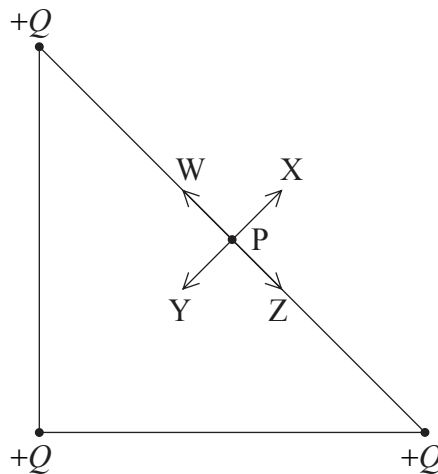
What is the magnitude of the current in the cell?

- A.  $\frac{\varepsilon}{3R}$
  - B.  $\frac{2\varepsilon}{3R}$
  - C.  $\frac{3\varepsilon}{2R}$
  - D.  $\frac{3\varepsilon}{R}$
18. A proton is accelerated from rest through a potential difference of 1000 V. What is the potential difference through which an alpha particle must be accelerated to gain the same kinetic energy as the accelerated proton?
- A. 4000 V
  - B. 2000 V
  - C. 500 V
  - D. 250 V

19. The magnitude of the gravitational field strength at the surface of a planet of mass  $M$  and radius  $R$  is  $g$ . What is the magnitude of the gravitational field strength at the surface of a planet of mass  $2M$  and radius  $2R$ ?

- A.  $\frac{g}{4}$
- B.  $\frac{g}{2}$
- C.  $g$
- D.  $2g$

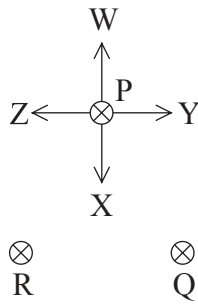
20. Three positive point charges  $+Q$  are fixed in position at the vertices of an isosceles triangle. P is the mid point between two of the charges.



Which arrow correctly identifies the direction of the electric field at point P?

- A. W
- B. X
- C. Y
- D. Z

21. Three wires, P, Q and R, carry equal currents directed into the plane of the paper.



Which arrow correctly identifies the direction of the magnetic force on wire P?

- A. W
  - B. X
  - C. Y
  - D. Z
22. Which particle is acted on by both the strong nuclear force and the Coulomb force?
- A. Antineutrino
  - B. Electron
  - C. Neutron
  - D. Proton
23. A nucleus of californium (Cf) contains 98 protons and 154 neutrons. Which of the following correctly identifies this nucleus of californium?
- A.  ${}_{252}^{98}\text{Cf}$
  - B.  ${}_{98}^{154}\text{Cf}$
  - C.  ${}_{98}^{252}\text{Cf}$
  - D.  ${}_{154}^{350}\text{Cf}$

24. Which of the following gives the particles of the same energy in an increasing order of ionizing ability?
- A.  $\beta, \alpha, \gamma$
  - B.  $\alpha, \beta, \gamma$
  - C.  $\gamma, \alpha, \beta$
  - D.  $\gamma, \beta, \alpha$
25. The use of which energy source enhances the greenhouse effect the most?
- A. Wood
  - B. Coal
  - C. Wind
  - D. Tidal
26. The volume expansion coefficient of water is  $\gamma$ . The average depth of the ocean is  $h$ .  
What is the expected fractional increase  $\frac{\Delta h}{h}$  in the sea level for a temperature increase of  $\Delta\theta$ ?
- A.  $\gamma\Delta\theta h$
  - B.  $\gamma\Delta\theta$
  - C.  $\frac{\gamma h}{\Delta\theta}$
  - D.  $\frac{\gamma}{\Delta\theta}$

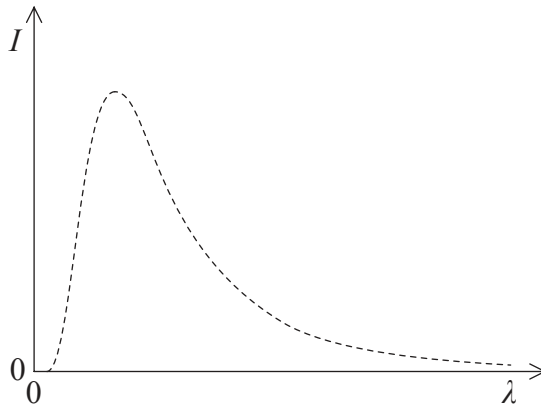
27. Which of the following correctly describes the energy transformation within photovoltaic cells and within solar heating panels?

	<b>Photovoltaic cells</b>	<b>Solar heating panels</b>
A.	solar to thermal	solar to electrical
B.	solar to thermal	solar to thermal
C.	solar to electrical	solar to electrical
D.	solar to electrical	solar to thermal

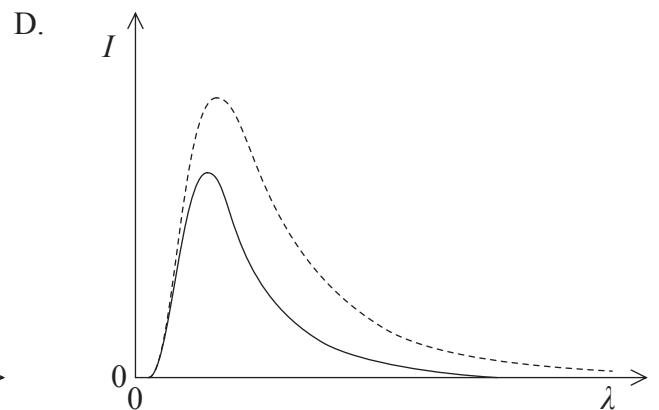
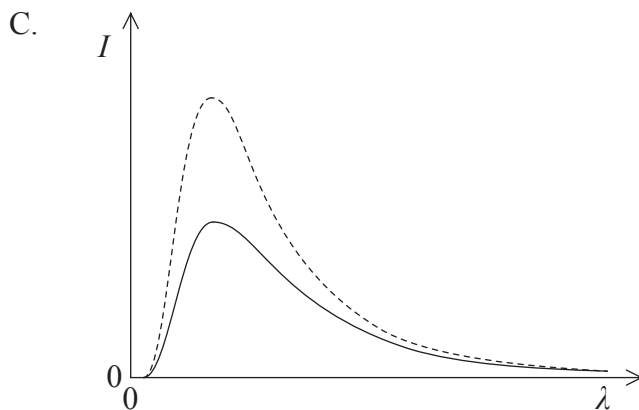
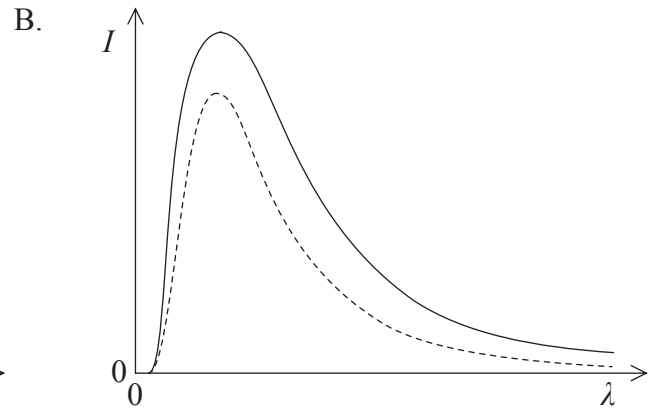
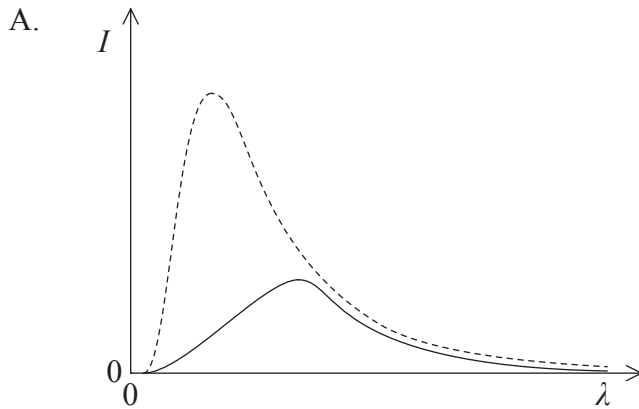
28. An oscillating water column (OWC) ocean-wave converter produces a power  $P$ . What is the power output of this converter if the amplitude and speed of the waves are both doubled?

- A.  $2P$
- B.  $4P$
- C.  $8P$
- D.  $16P$

29. The graph shows the spectrum of a black-body.



Which graph shows the spectrum of a body of emissivity 0.5 at the same temperature as the black-body? (The original graph is shown dotted.)



30. A student states that the following factors may lead to global warming
- I. decreased albedo of the Earth's surface
  - II. increase in volcanic activity
  - III. deforestation.

Which of the above statements are correct?

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