



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

Tuesday 9 May 2006 (afternoon)

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.

1. An object has an acceleration of  $2.0 \text{ m s}^{-2}$ . Which of the following gives the change in the speed of the object after 7.00 s to the correct number of significant digits?
- A.  $14 \text{ m s}^{-1}$
  - B.  $14.0 \text{ m s}^{-1}$
  - C.  $14.00 \text{ m s}^{-1}$
  - D.  $14.000 \text{ m s}^{-1}$

2. A particle is moving in a circular path of radius  $r$ . The time taken for one complete revolution is  $T$ . The acceleration  $a$  of the particle is given by the expression

$$a = \frac{4\pi^2 r}{T^2}.$$

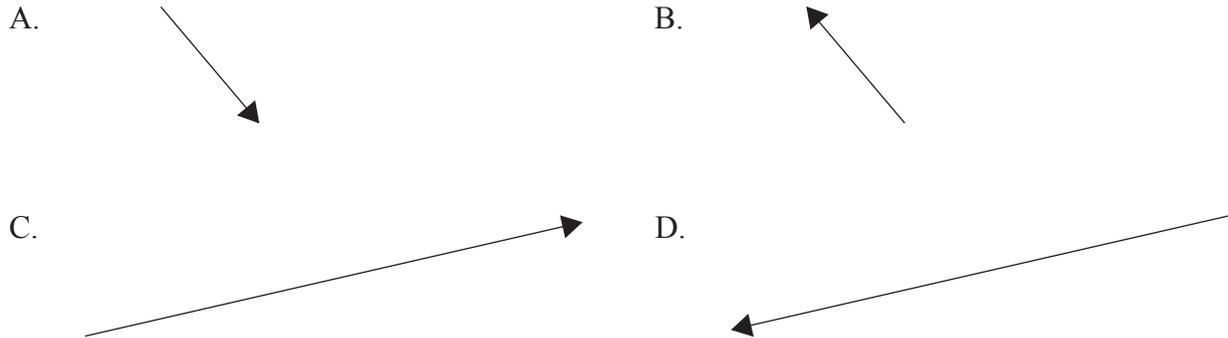
Which of the following graphs would produce a straight-line?

- A.  $a$  against  $T$
- B.  $a$  against  $T^2$
- C.  $a$  against  $\frac{1}{T}$
- D.  $a$  against  $\frac{1}{T^2}$

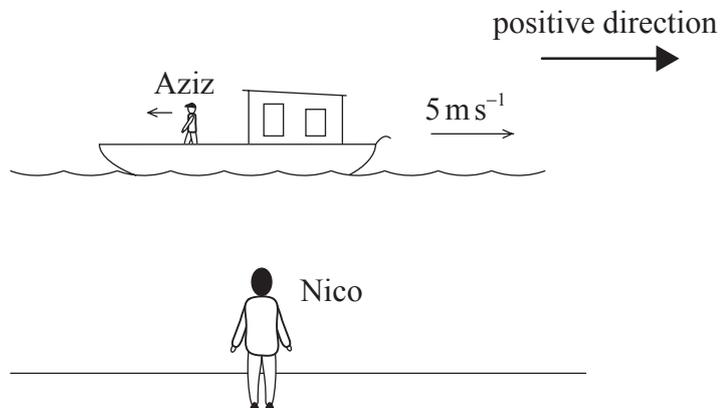
3. The diagram below shows two vectors,  $x$  and  $y$ .



Which of the vectors below best represents the vector  $c$  that would satisfy the relation  $c = x + y$ ?



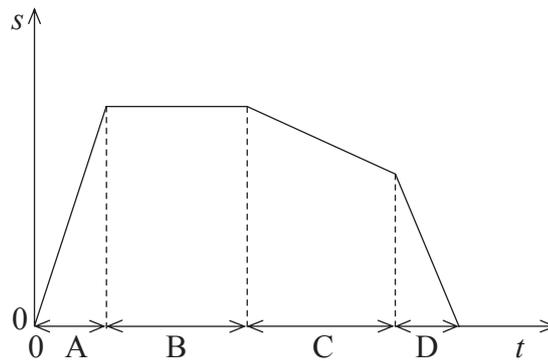
4. A boat is moving in the direction shown with a speed of  $5 \text{ m s}^{-1}$  as measured by Nico who is at rest on the beach. Aziz walks along the deck of the boat in the direction shown with a speed of  $2 \text{ m s}^{-1}$  measured relative to the boat.



If velocity is measured as positive in the direction shown, the **velocity** of Nico relative to Aziz is

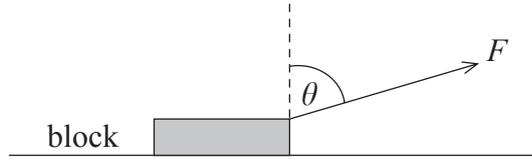
- A.  $-7 \text{ m s}^{-1}$ .
- B.  $-3 \text{ m s}^{-1}$ .
- C.  $+3 \text{ m s}^{-1}$ .
- D.  $+7 \text{ m s}^{-1}$ .

5. The graph below shows the variation with time  $t$  of the displacement  $s$  of a car. In which time interval is the speed greatest?



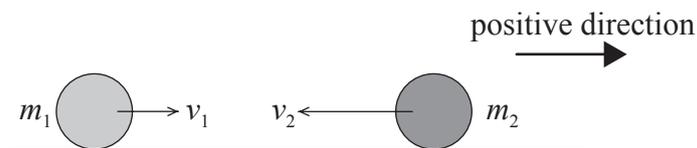
6. The velocity of a particle is changing. The rate of change of the momentum of the particle is equal to the
- A. acceleration of the particle.
  - B. net force acting on the particle.
  - C. work done on the particle.
  - D. change in kinetic energy of the particle.

7. A block of mass  $m$  is pulled along a horizontal, frictionless surface by a force of magnitude  $F$ . The force makes an angle  $\theta$  with the vertical.



The magnitude of the acceleration of the block in the horizontal direction produced by the force  $F$  is

- A.  $\frac{F}{m}$ .
- B.  $\frac{F \sin \theta}{m}$ .
- C.  $\frac{F \cos \theta}{m}$ .
- D.  $\frac{F \tan \theta}{m}$ .
8. Two spheres of masses  $m_1$  and  $m_2$  are moving towards each other along the same straight-line with speeds  $v_1$  and  $v_2$  as shown.



The spheres collide. Which of the following gives the total change in linear momentum of the spheres as a result of the collision?

- A. 0
- B.  $m_1 v_1 + m_2 v_2$
- C.  $m_1 v_1 - m_2 v_2$
- D.  $m_2 v_2 - m_1 v_1$

9. An object of mass  $m$  is initially at rest. An impulse  $I$  acts on the object. The change in kinetic energy of the object is

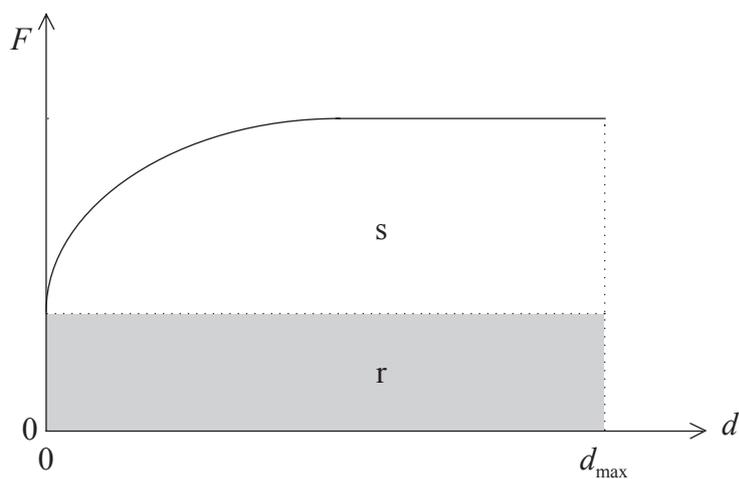
A.  $\frac{I^2}{2m}$ .

B.  $\frac{I^2}{m}$ .

C.  $I^2m$ .

D.  $2I^2m$ .

10. The graph below shows the variation with displacement  $d$  of the force  $F$  acting on a particle.



The area that represents the work done by the force between  $d=0$  and  $d=d_{\max}$  is

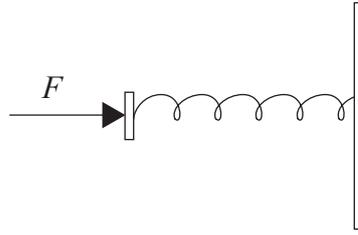
A.  $s - r$ .

B.  $r$ .

C.  $s$ .

D.  $s + r$ .

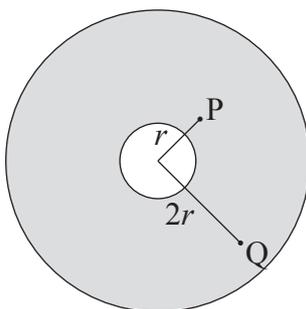
11. A spring is compressed by a force  $F$ .



For a compression  $e$ , the force  $F$  is given by  $F=ke$ . When the compression force is removed, the spring returns to its original length in time  $t$ . The best estimate for the power developed by the spring during its expansion is

- A.  $\frac{ke}{2t}$ .
- B.  $\frac{ke}{t}$ .
- C.  $\frac{ke^2}{2t}$ .
- D.  $\frac{ke^2}{t}$ .

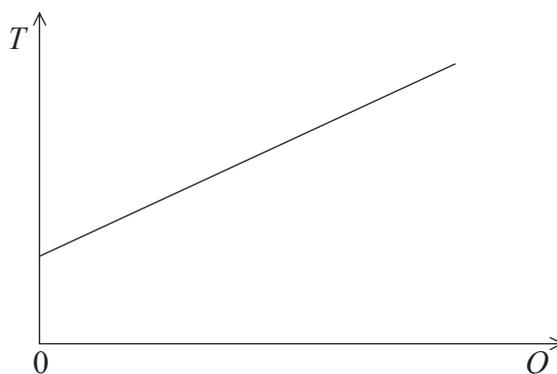
12. Two points P and Q are at distances  $r$  and  $2r$  respectively from the centre of a compact disc (CD) as shown.



When the disc is rotating about its centre, the ratio of the  $\frac{\text{acceleration at P}}{\text{acceleration at Q}}$  is

- A.  $\frac{1}{2}$ .
- B. 1.
- C.  $\sqrt{2}$ .
- D. 2.
13. The internal energy of a solid substance is equal to the
- A. average kinetic energy of the molecules.
- B. total kinetic energy of the molecules.
- C. total potential energy of the molecules.
- D. total potential and total kinetic energy of the molecules.

14. The specific heat capacity  $c$  of a solid block of mass  $m$  is determined by heating the block and measuring its temperature. The graph below shows the variation of the temperature  $T$  of the block with the thermal energy  $Q$  transferred to the block.

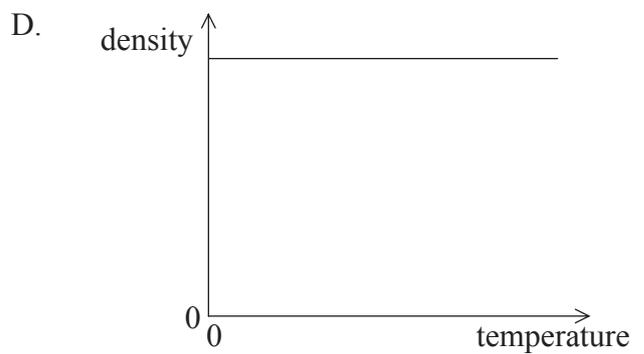
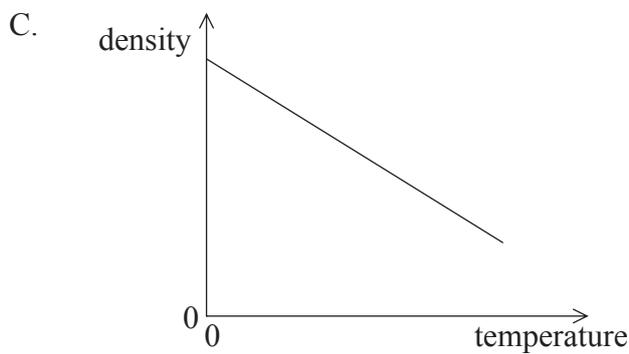
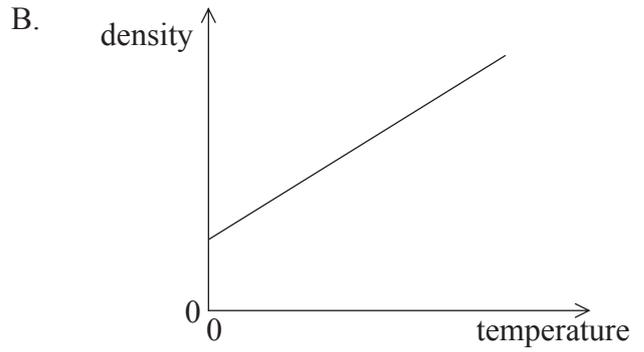
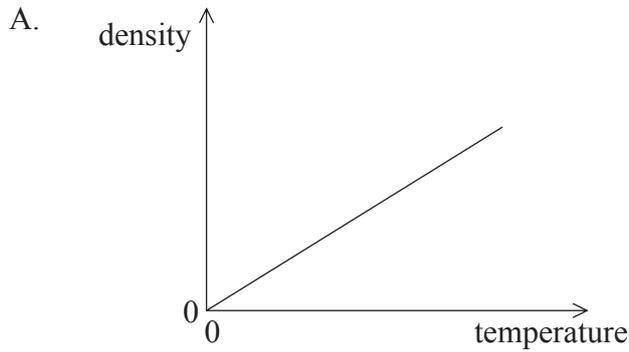


The gradient of the line is equal to

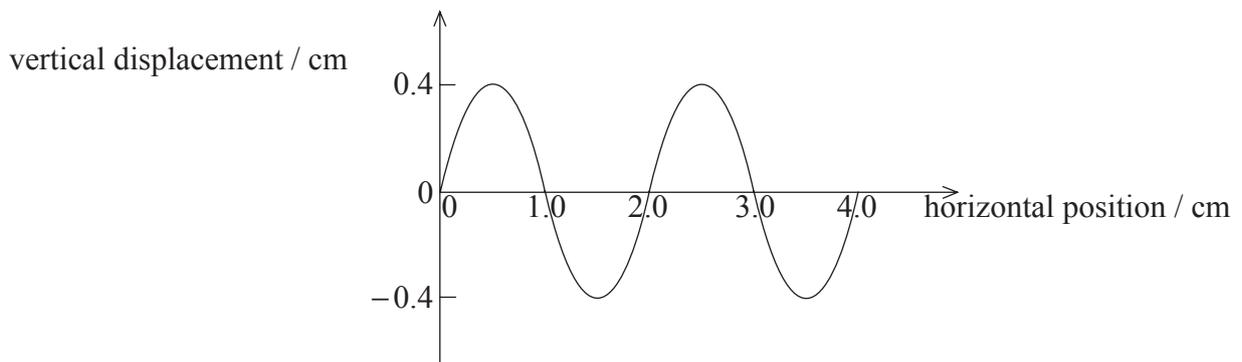
- A.  $\frac{c}{m}$ .
- B.  $\frac{m}{c}$ .
- C.  $mc$ .
- D.  $\frac{1}{mc}$ .
15. Which of the following correctly shows the changes, if any, in the potential energy and in the kinetic energy of the molecules of a solid as it melts?

	Potential energy	Kinetic energy
A.	Decreases	Increases
B.	Increases	Stays the same
C.	Stays the same	Decreases
D.	Stays the same	Stays the same

16. A fixed mass of an ideal gas is heated at constant volume. Which of the following graphs correctly shows the variation with temperature of the density of the gas?



17. A source produces water waves of frequency 10 Hz. The graph shows the variation with horizontal position of the vertical displacement of the surface of water at one instant in time.



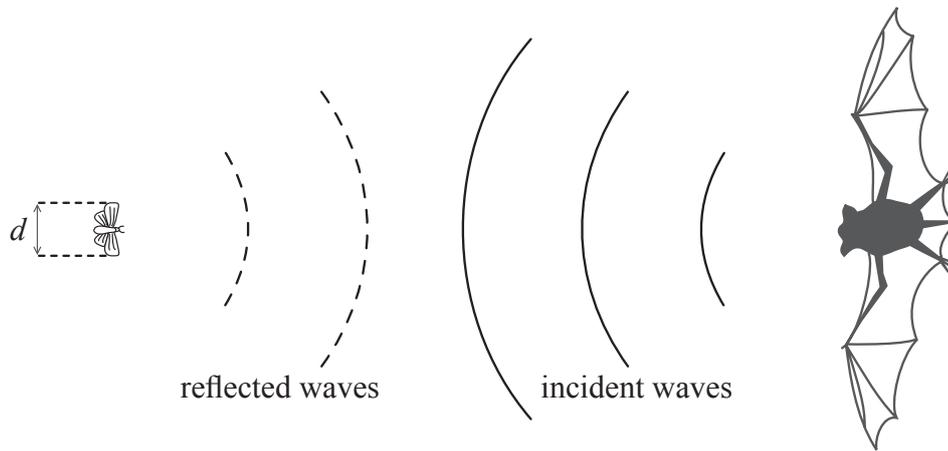
The speed of the water waves is

- A.  $0.20 \text{ cm s}^{-1}$ .
- B.  $4.0 \text{ cm s}^{-1}$ .
- C.  $10 \text{ cm s}^{-1}$ .
- D.  $20 \text{ cm s}^{-1}$ .

18. A wave travels from one medium to another. Which of the following is true about its frequency and wavelength?

	Frequency	Wavelength
A.	No change	No change
B.	Change	No change
C.	No change	Change
D.	Change	Change

19. A bat approaches an insect of wing span length  $d$ . The bat emits a sound wave. The bat detects the insect if the sound is reflected from the insect.



The insect will **not** be located if

- A. the insect's speed is less than the speed of the sound wave.
- B. the insect's wing beat frequency is greater than the frequency of the sound wave.
- C. the length  $d$  is much greater than the wavelength of the sound wave.
- D. the length  $d$  is much smaller than the wavelength of the sound wave.

20. The speed of sound in air at room temperature is  $v$ . An organ pipe of length  $l$  is closed at one end. The frequency of the fundamental (first harmonic) of the sound emitted by the pipe is

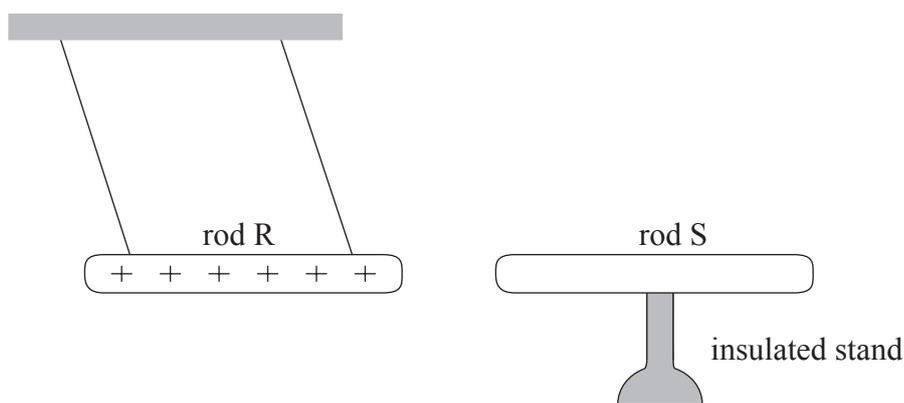
A.  $\frac{v}{4l}$ .

B.  $\frac{v}{2l}$ .

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

D.  $vl$ .

21. The diagram below shows a charged rod R suspended by insulating strings. When a stationary rod S is placed nearby, rod R is attracted towards it.



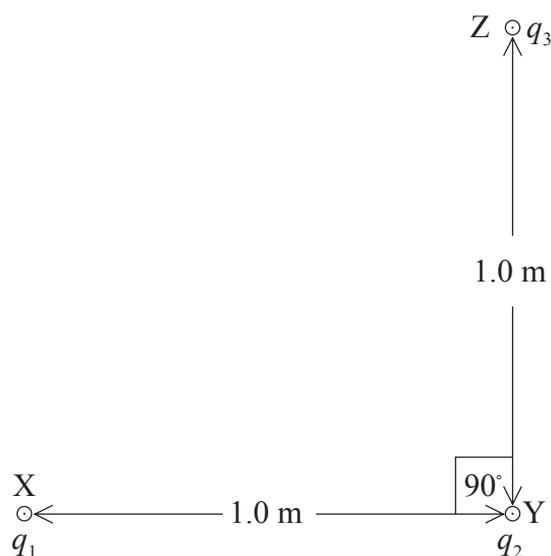
Consider the following statements regarding the possible nature of the rod S.

- I. Rod S is charged
- II. Rod S is an uncharged insulator.
- III. Rod S is an uncharged conductor.

Which statement(s) can explain the attraction of rod R to rod S?

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

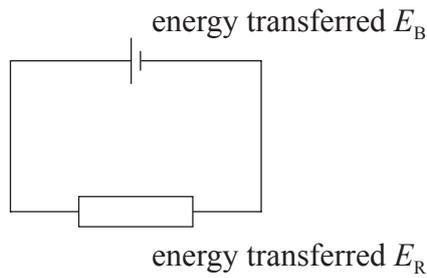
22. Three equal point charges X, Y and Z are fixed in the positions shown.



The distance between  $q_1$  and  $q_2$  and the distance between  $q_2$  and  $q_3$  is 1.0 m. The electric force between the charges at X and Y is  $F$ . The electric force between the charges at X and Z is

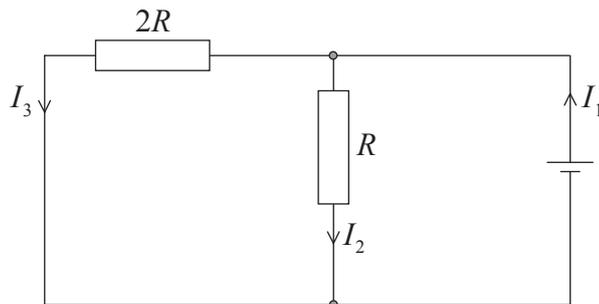
- A.  $\frac{F}{2}$ .
- B.  $\frac{F}{\sqrt{2}}$ .
- C.  $F$ .
- D.  $2F$ .
23. A proton of mass  $m$  and charge  $e$  is accelerated from rest through a potential difference  $V$ . The final speed of the proton is
- A.  $\sqrt{\frac{2Ve}{m}}$ .
- B.  $\frac{2Ve}{m}$ .
- C.  $\sqrt{\frac{Ve}{m}}$ .
- D.  $\frac{Ve}{m}$ .

24. A battery is connected to a resistor as shown below.



The battery transfers energy  $E_B$  when charge  $Q$  passes completely around the circuit and the resistor transfers energy  $E_R$ . The e.m.f. of the battery is equal to

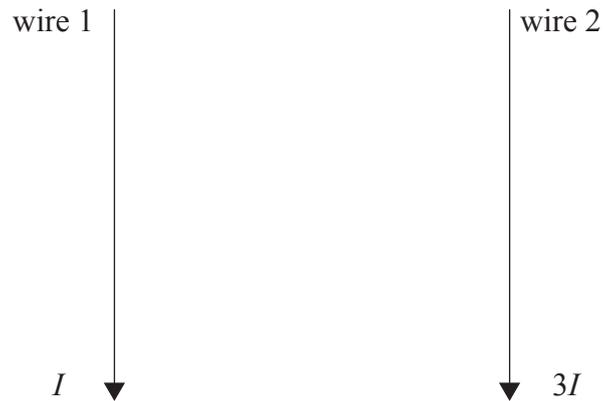
- A.  $\frac{E_R}{Q}$ .
- B.  $\frac{E_B}{Q}$ .
- C.  $\frac{E_B + E_R}{Q}$ .
- D.  $\frac{E_B - E_R}{Q}$ .
25. In the circuit shown below, the cell has negligible internal resistance.



Which of the following equations is correct?

- A.  $I_1 = 2I_2$
- B.  $I_1 = 2I_3$
- C.  $I_2 = 2I_3$
- D.  $I_3 = 2I_1$

26. The currents in two parallel wires are  $I$  and  $3I$  in the directions shown in the diagram below.



The magnetic force on wire 2 due to the current in wire 1 is  $F$ . The magnitude of the force on wire 1 due to the current in wire 2 is

- A.  $\frac{F}{3}$ .
  - B.  $\frac{F}{2}$ .
  - C.  $F$ .
  - D.  $3F$ .
27. Which of the following identifies the **significant** interaction(s) between nucleons inside the nucleus?
- A. Nuclear only
  - B. Coulomb only
  - C. Nuclear and Coulomb
  - D. Gravitational, nuclear and Coulomb

28. The initial activity of a sample of a radioactive isotope of half-life 10 hours is  $A$ . What is the age of the sample when its activity is  $\frac{A}{32}$ ?
- A. 30 hours
  - B. 40 hours
  - C. 50 hours
  - D. 320 hours

29. The following is a nuclear reaction equation.



X is

- A. an alpha particle.
  - B. a neutron.
  - C. a proton.
  - D. an electron.
30. Two light nuclei of masses  $m_1$  and  $m_2$  fuse in a nuclear reaction to form a nucleus of mass  $M$ . Which of the following expressions correctly relates the masses of the nuclei?
- A.  $M > m_1 + m_2$
  - B.  $M < m_1 + m_2$
  - C.  $M = m_1 + m_2$
  - D.  $M = m_1 - m_2$
-