

## Physics, 2005 EC, entrance exam

Grade 12 · Physics · 2005 E.C.

Time allowed: 120 minutes

Questions: 39

Total marks: 39

Name \_\_\_\_\_ Grade \_\_\_\_\_ ID No. \_\_\_\_\_ Date \_\_\_\_\_

1. Which of the following is correct about the meaning of Photon? (1)
- A. quantum of matter                      B. positively charged particle  
C. negatively charged particle              D. quantum of light
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2. Consider a series RC circuit for which  $R = 1.0 \text{ M}\Omega$ ,  $C = 5 \text{ }\mu\text{F}$  and  $\varepsilon = 30 \text{ V}$ . What is the time constant of the circuit and the maximum charge on the capacitor after the switch is closed respectively? (1)
- A. 5 seconds,  $150 \text{ }\Omega\text{C}$                       B. 7 seconds,  $155 \text{ }\Omega\text{C}$   
C. 10 seconds,  $160 \text{ }\Omega\text{C}$                       D. 9 seconds,  $135 \text{ Mc}$
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3. What is the direction with which a fish must push the water with its fins in order to propel eastward? (1)
- A. eastward                                      B. upward  
C. westward                                      D. downward
- 
4. Two non-zero vectors  $\vec{A}$  and  $\vec{B}$  are related by  $\vec{A} = c\vec{B}$  where  $c$  is a scalar. If the two vectors have opposite directions, then one of the following is true about  $c$ ? (1)
- A.  $c$  is a positive number                      B.  $c$  is a negative number  
C.  $c = 1$                                               D.  $c = 0$
- 
5. On which of the following does the induced emf in a coil NOT depend when a magnet is inserted into it? (1)
- A. resistance of the coil                      B. number of turns of the coil  
C. speed approach of the magnet              D. magnetic moment of the magnet
- 
6. A wave have a speed of  $50 \text{ m/s}$  and a wavelength of  $25,000 \text{ m}$ . What is the frequency of the wave? (1)
- A.  $2.0 \times 10^{-3} \text{ Hz}$                               B.  $5.0 \times 10^{-2} \text{ Hz}$   
C.  $6.0 \times 10^1 \text{ Hz}$                               D.  $1.8 \times 10^6 \text{ Hz}$
- 
7. In a reversible thermodynamic process, the system (1)
- A. is always close to equilibrium states  
B. might never be close to any equilibrium states  
C. is close to equilibrium states only at the beginning and end  
D. is close to equilibrium states throughout, except at the beginning and end

8. Points A and B are each a distance  $d$  from each of two equal and opposite charge as shown below. What will be the work required to move a negative charge  $q$  from A to B? (1)
- [Figure: A hand-drawn rhombus (diamond) standing on one of its diagonals. The point A is at the top vertex and the point B is at the bottom vertex. A large circle labelled  $+Q$  sits at the left vertex and a large circle labelled  $-Q$  sits at the right vertex; a straight horizontal line joins the two charges through the centre, and a straight vertical line joins A to B through the same centre. Each of the four sides of the rhombus is labelled  $d$ : the upper-left side (from  $+Q$  to A), the upper-right side (from A to  $-Q$ ), the lower-left side (from  $+Q$  to B) and the lower-right side (from B to  $-Q$ ).]
- A. zero  
B.  $\frac{qQ}{4\pi\epsilon_0 d^2}$   
C.  $\frac{qQ}{4\pi\epsilon_0 d}$   
D.  $\frac{qQ}{4\pi\epsilon_0 (4d^2)}$
- 
9. An air-filled parallel-plate capacitor has a capacitance of 1Pf. The plate separation is then doubled and a wax dielectric is inserted, completely filling the space between the plates. As a result, the capacitance becomes 2 Pf. What is the dielectric constant of the wax? (1)
- A. 8.0  
B. 4.0  
C. 2.0  
D. 0.5
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10. A step-up transformer is used to (1)
- A. increase the power  
B. decrease the power  
C. increase the voltage  
D. decrease the voltage
- 
11. A 220-V power line is protected by a 15-A fuse. What is the maximum number of "220V, 500W" light bulbs that can be operated at full brightness from this line? (1)
- A. 2  
B. 4  
C. 6  
D. 8
- 
12. If  $\vec{A} = 8\vec{i} + \vec{j} - 2\vec{k}$  and  $\vec{B} = 5\vec{i} - 3\vec{j} + \vec{k}$ , then what is the value of  $\vec{B} \times \vec{A}$ ? (1)
- A.  $3\vec{i} + 4\vec{j} - 3\vec{k}$   
B.  $-3\vec{i} - 4\vec{j} + 3\vec{k}$   
C.  $-5\vec{i} - 18\vec{j} - 29\vec{k}$   
D.  $5\vec{i} + 18\vec{j} + 29\vec{k}$
- 
13. The coordinate of a particle in meters is given by  $X(t) = 25t - 3t^2$ , where the time  $t$  is in seconds. At what value of  $t$  will the particle become momentarily at rest? (1)
- A. 2.78s  
B. 1.67s  
C. 0.6s  
D. 0.36s
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14. A woman driving a 2000 kg car along a level road at 30m/s takes her foot off the gas to see how far her car will roll before it slows to a stop. She discovers that it takes 150m. What is the average force of friction acting on the car? (1)
- A. 9000N  
B. 6000N  
C. 3000N  
D. 400N
- 
15. The radius of the wheel shown below is 0.75m. What is its moment of inertia? (1)
- [Figure: A hand-drawn wheel: a large circle (the rim) with a small hub at the centre and four straight spokes running from the hub to the rim at the top, bottom, left and right. Where each spoke meets the rim there is a small circle representing a point mass, and each of the four masses is labelled 3kg.]
- A.  $2.25 \text{ kgm}^2$   
B.  $3.38 \text{ kgm}^2$   
C.  $6.75 \text{ kgm}^2$   
D.  $9.00 \text{ kgm}^2$

- 16.** The length of an aluminium rod at a temperature of  $20^{\circ}\text{C}$  is 3m. What will be the ratio of change in the length of the rod to its original length if its temperature is raised to  $120^{\circ}\text{C}$ ? the coefficient of linear expansion of aluminium is  $3.31 \times 10^{-5}/\text{K}$

  - A. 23%
  - B. 3.2%
  - C. 3%
  - D. 0.23%

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**17.** A very large open tank is full of oil whose density is  $800\text{kg/m}^3$ . If the absolute pressure at the bottom of the tank is  $1.81 \times 10^5 \text{ Pa}$ , then what is the depth of the oil? (Note that atmospheric pressure is  $1.01 \times 10^5 \text{ Pa}$ )

  - A. 100.0m
  - B. 75.0m
  - C. 10.0m
  - D. 9.5m

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**18.** A 1.5kg particle moves in the xy-plane with velocity  $\vec{v} = (4.2\hat{i} - 3.6\hat{j})\text{ m/s}$  what is its angular momentum when the position vector is  $\vec{r} = (1.5\hat{i} + 2.2\hat{j})\text{ m}$ ?

  - A.  $-22\hat{k} \text{ kgm}^2/\text{s}$
  - B.  $14.6\hat{k} \text{ kgm}^2/\text{s}$
  - C.  $-14.6\hat{k} \text{ kgm}^2/\text{s}$
  - D.  $22\hat{k} \text{ kgm}^2/\text{s}$

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**19.** A 2kg object experiences two concurrent forces of 100N at  $30^\circ$  above the positive x-axis and 80N at  $60^\circ$  above the negative x-axis. What is the magnitude of acceleration of the object?

  - A.  $68 \text{ m/s}^2$
  - B.  $64 \text{ m/s}^2$
  - C.  $48 \text{ m/s}^2$
  - D.  $46 \text{ m/s}^2$

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**20.** A driver moving at a constant speed of  $20\text{m/s}$  sees an accident up ahead and hits the brakes. If the car decelerates at a constant rate of  $-5 \text{ m/s}^2$ , how far does the car go before it comes to a stop?

  - A. 120m
  - B. 100m
  - C. 40m
  - D. 20m

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**21.** Which device uses the principle of electromagnetic induction for its operation?

  - A. AC generator
  - B. moving coil meter
  - C. cathode ray tube
  - D. light emitting diode

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**22.** An electron enters a region of uniform electric field of  $5 \times 10^3 \text{ N/C}$ . what is the force on the electron?

  - A.  $8 \times 10^{-22}\text{N}$
  - B.  $5.3 \times 10^{-22}\text{N}$
  - C.  $8 \times 10^{-16}\text{N}$
  - D.  $1.88 \times 10^{22}\text{N}$

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**23.** In the circuit shown below, what is the potential difference between points B and D?  
[Figure: A hand-drawn circuit. A 6 V battery sits in the top wire of an outer rectangular loop. The left-hand side of that loop comes down to a node labelled A and the right-hand side comes down to a node labelled C. Between A and C there are two parallel branches. The upper branch runs from A through a 6 ohm resistor to a point labelled B and then through a 12 ohm resistor to C. The lower branch runs from A through a 12 ohm resistor to a point labelled D and then through a 6 ohm resistor to C.]

  - A. 1V
  - B. 2V
  - C. 3V
  - D. 4V

24. The planet Jupiter is about 318 times as massive as earth, yet on its surface you would weigh only about 2.4 times your weight on earth. Why is this happened? (1)
- Your mass is 132.5 times less on Jupiter.
  - You are 132.5 times more weightless there.
  - Jupiter is significantly farther from the sun.
  - Jupiter's radius is about 11.5 times the earth's radius.
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25. A uniform ball of radius  $r$  and mass  $m$  starts from rest and rolls down a frictionless incline of height  $h$ . when the ball reaches the ground, how fast is it going? (1)
- $\sqrt{\frac{10}{7}gh}$
  - $\sqrt{\frac{9}{10}gh}$
  - $\sqrt{\frac{10}{9}gh}$
  - $\sqrt{\frac{7}{10}gh}$
- 
26. A ladder of length 3m and mass 20 kg leans against a smooth, vertical wall so that the angle between the wall and the ladder is  $30^\circ$ . What are the magnitudes of the normal forces at the contact point on the wall ( $N_w$ ) and at the contact point on the ground? (1)
- $N_w = 0 \text{ N}, N_g = 200 \text{ N}$
  - $N_w = 200 \text{ N}, N_g = 0 \text{ N}$
  - $N_w = 57.7 \text{ N}, N_g = 200 \text{ N}$
  - $N_w = 200 \text{ N}, N_g = 57.7 \text{ N}$
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27. A container resting on the floor of an elevator contains an incompressible fluid of density  $\rho$ . When the elevator has an upward acceleration of magnitude "a" then what will be the pressure difference between two points in the fluid separated by a vertical distance  $\Delta h$ ? (1)
- $\rho a \Delta h$
  - $\rho(g + a)\Delta h$
  - $\rho g \Delta h$
  - $\rho g a \Delta h$
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28. If two particles have equal momenta, then which one of the following statements is TRUE about their kinetic energies? (1)
- Their kinetic energies are always equal.
  - Their kinetic energies are never equal.
  - Their kinetic energies are equal when their masses are the same.
  - Their kinetic energies are equal when the speed of one of the particle is half the speed of the other and their masses are the same.
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29. In Young's double slit experiment both the separation between the slits and the distance between the slits and the screen are halved then, what is the fringe width? (1)
- halved
  - unchanged
  - zero
  - doubled
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30. What is the capacitance of a capacitor that should be connected with 2 other capacitors having capacitance of 4F and 8F all in series to produce an effective capacitance of  $\frac{24}{11} \mu\text{F}$ ? (1)
- $12 \mu\text{F}$
  - $10 \mu\text{F}$
  - $8 \mu\text{F}$
  - $4 \mu\text{F}$

31. A particle of mass  $m$  is fired into a magnetic field of strength  $B$  at speed  $V$ . the particle travels in a circular path inside the field with a radius  $r$ . which of the following expressions gives the magnitude of the charge on the particle?

A.  $\frac{mr}{vB}$  B.  $\frac{mv^2}{Br}$   
 C.  $\frac{vB}{mr}$  D.  $\frac{mv}{Br}$

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32. An alternating current is represented by  $I(t) = 10.0 \text{ A} \sin(100\pi t)$ . What are the amplitude and frequency of the alternating current?

A. 100A, 75Hz B. 10.0A, 100Hz  
 C. 10.0A, 50Hz D. 5.0A, 25Hz

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33. Suppose that a voltage source produces 240V for a moment. By what percentage does the power output of 220V light bulb increases?

A. 38% B. 36%  
 C. 19% D. 18%

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34. A wire carries a steady current of 2.4A. A straight section of the wire is 0.75 m long and lies along the x-axis within a uniform magnetic field  $B = 1.6\text{T}$  along the +z axis. If the current is in the +x direction. What is the magnetic force on the section of the wire?

A. 2.88j N B. 1.62i N  
 C. (-1.62j) N D. (-2.88k) N

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35. If all the three resistors in the circuit shown in the figure have equal resistance , and the current flowing into resistor B is 4A, then what is the current flowing into resistor G?  
*[Figure: A hand-drawn circuit on a rectangular frame with a battery in the left-hand side. Two parallel horizontal branches run between the left and right vertical wires near the top of the frame: the upper branch contains two resistors in series labelled B (on the left) and C (on the right); the branch immediately below it contains two resistors in series labelled D (on the left) and E (on the right). On the right-hand vertical wire, below where those two branches join, there is a resistor labelled F. Along the bottom wire, which returns to the battery, there is a resistor labelled G.]*

A. 16A B. 8A  
 C. 2A D. 1A

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36. Refraction of a wave does NOT involve change in its

A. speed B. wavelength  
 C. frequency D. speed and wavelength

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37. Gas at a pressure  $P$  is contained in a vessel. If the masses of all the molecules are doubled and their speeds are half, then what will be the resulting pressure?

A.  $2P$  B.  $P/3$   
 C.  $P/2$  D.  $3P$

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38. Water flows through a fire hose of diameter 6.35cm at a rate of  $0.012 \text{ m}^3/\text{s}$ . the fire hose ends in a nozzle of inner diameter 2.20cm. What is the speed with which the water exits the nozzle?

A. 63.2m/s B. 46.8m/s  
 C. 31.6m/s D. 23.4 m/s

