LA SALLE COLLEGE

F5

F5 PHYSICS

Final Examination 2014 to 2015

8:10 am – 9:55 am (1¾ hours)

Exam Number			

Section A

General Instructions

1. This paper consists of THREE sections, Section A (Multiple Choice Questions), Section B (Short Questions) and Section C (Long Questions). Section A carries 30 marks, Section B carries 28 marks and Section C carries 42 marks.

2. Answer all questions.

3. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Sections B and C should be written in the spaces provided in the Question-Answer Book.

4. The last two pages of the Question-Answer Book of Sections B and C contain a list of data, formulae and relationships which you may find useful.

Instructions for Section A

1. Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first write you Exam Number on the cover page of the question paper and insert the information required in the spaces provided on the Answer Sheet.

2. When told to turn over the paper, check that all the questions are there. Look for the words '**END OF SECTION A**' after the last question.

3. All questions carry equal marks.

4. Mark the answers of the Section A with an HB pencil on the Answer Sheet. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.

5. Choose the best answer. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

6. No marks will be deducted for wrong answers.

Section A : Multiple Choice Questions (30 marks)

There are 30 questions in this section. Each question is followed by four suggested answers. Choose the **BEST** answer from the four options.

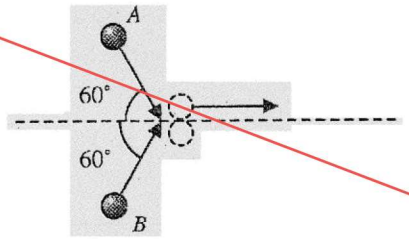
Where necessary, take the acceleration due to gravity to be 9.81 ms^{-2} and take the speed of light in air to be 3×10^{8} ms^{-1}.

1. A ball is projected to the right with a speed 15 ms^{-1} and moves in horizontal. The acceleration of the ball is 3 ms^{-2} to the left. What is the time required for the ball to be 55 m apart from its starting position?

A. 2.9 s
B. 12.9 s
C. 37.5 s
D. The ball cannot go so far.

2. Two balls *A* and *B* collide with each other at an angle as shown in Figure 1. The mass of ball *A* is double that of ball *B* while the speed of ball *B* is double that of ball *A*. The balls move together after collision.

Figure 1



What is the ratio of the total kinetic energy of the balls before and after the collision?

A. 3 : 1
B. 6 : 1
C. 3 : 2
D. 9 : 2

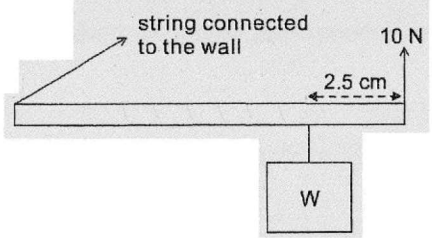
3. Two balls with different masses are launched at the same height above the ground. One is projected upwards while the other is projected horizontally with the same speed. Which of the following physical quantities is/are the same for the balls when they hit the ground?

(1) speed
(2) kinetic energy
(3) mechanical energy

A. (1) only
B. (3) only
C. (1) and (3) only
D. (2) and (3) only

4. A box is suspended on a uniform rod of mass 0.4 kg and length10 cm. The rod is set in equilibrium along the horizontal; the left end of the rod is connected to a wall with a string while the vertical component of the force acting at its right end is 10 N. Find the weight of the box.

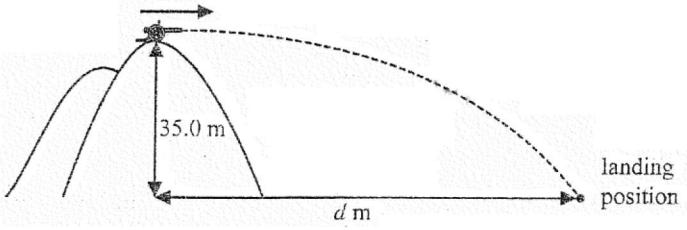
Figure 2



A. 7.5 N
B. 10.7 N
C. 13.3 N
D. Cannot be determined.

5. A cannon ball is fired horizontally from the top of a hill which is 35.0 m above the ground on the Earth as shown in Figure 3. The horizontal distance travelled by the cannon ball on hitting the ground is d m. The same experiment is then carried out on the surface of the Moon. It the acceleration due to gravity on the Moon is one-sixth that on the Earth, what would be the new horizontal distance?

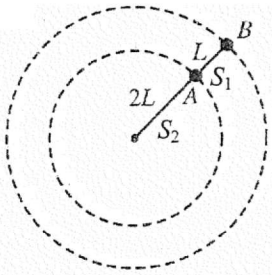
Figure 3



A. 2.45 d m B. 4.90 d m C. 6.00 d m D. 12.0 d m

6.

Figure 4



Two identical small beads A and B are set into uniform circular motion with the same angular speed about a fixed point on the surface of a smooth horizontal table as shown in Figure 4. Beads A and B are connected by a light inextensible string S_1 of length L, while A is connected to the fixed point by another inextensible string S_2 of length $2L$. What is the ratio of the tension in the string S_1 to that in the string S_2?

A. 1 : 2 B. 1 : 3 C. 3 : 2 D. 3 : 5

7. A 107 kg bob is connected to the ceiling by a 1.05 m light inextensible string and set to move in a horizontal circle, it takes a minute for the bob to turn 30 revolutions. What is the tension in the string?

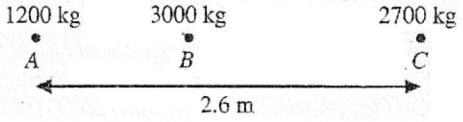
A. 290.9 N B. 1032.5 N C. 1108.9 N D. 4078.0 N

8. When the road is dry, the maximum speed for a car to turn safely around a corner is 18 m s^{-1}. On a rainy day, the maximum friction between the tyres and the road surface is reduced to 40% of that when the road is dry. Find the maximum speed for the car to turn safely around the same corner on a rainy day.

A. 2.9 m s^{-1} B. 5.7 m s^{-1} C. 7.2 m s^{-1} D. 11.4 m s^{-1}

9. 1n Figure 5, three objects A, B and C are aligned in a straight line. The masses of the three objects are 1200 kg, 3000 kg and 2700 kg respectively. The separation between objects A and C is 2.6 m. The net gravitational force acting on B is zero.

Figure 5



Assume that the sizes of the three objects are negligible. Find the separation between objects A and B.

A. 0.80 m B. 1.04 m C. 1.56 m D. 1.80 m

10. The radius of a planet X is 1.5 times that of the Earth. The gravitational field strength at the surface of planet X is just the same as that at the surface of the Earth. If the density of the Earth is ρ, what is the density of planet X?

A. 0.44 ρ B. 0.67 ρ C. 1.5 ρ D. 2.25 ρ

11. 70 g of oxygen gas is kept in an inexpansible vessel at a temperature of 500 K. If it is heated to 700 K under constant pressure, what is the amount of oxygen, in term of moles, expelled from the vessel? Assume oxygen gas obeys ideal gas law. (Molar mass of oxygen = 32 g mol^{-1})

A. 0.63 mol B. 0.88 mol C. 20 mol D. 28 mol

12. A vessel contains an ideal gas. The pressure inside the vessel is 5 x 10^5 Pa. The r.m.s. speed of the gas molecules is 650 ms^{-1}. Find the density of the gas.

A. 1.2 kgm^{-3} B. 3.6 kgm^{-3}
C. 2307.7 kgm^{-3} D. Cannot be determined as the volume is not given.

13. For the same mass of hydrogen and argon at the same temperature and volume, which of the following statements is INCORRECT?
A. Average kinetic energy of molecules is the same.
B. Average potential energy of molecules is the same.
C. Pressure is the same.
D. Number of moles of molecules are different.

14. Three conducting spheres are suspended by separate nylon threads. When any two of them are brought near each other, they attract each other. Which of the following deductions is CORRECT?

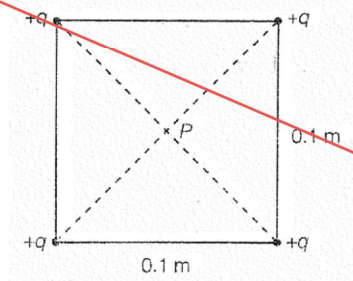
A. All three spheres are charged.
B. Only one sphere is charged and the other two are uncharged.
C. One sphere is uncharged and the other two carry like charges.
D. One sphere is uncharged and the other two carry unlike charges.

15. Particle X carries a mass m_X and a charge q_X, and particle Y carries a mass m_Y and a charge q_Y. When both particles X and Y are accelerated from rest through the same potential difference, they attain the same final speed. Which of the following relationships is necessary for the particles?

A. $m_X q_X = m_Y q_Y$ B. $m_X {q_X}^2 = m_Y {q_Y}^2$ C. $m_X q_Y = m_Y q_X$ D. $m_X {q_Y}^2 = m_Y {q_X}^2$

16. The electric potential at a distance 0.1 m from a point charge $+q$ in vacuum is 1 000 V. Now four such point charges are fixed at the corners of a square of side 0.1 m in vacuum as shown in Figure 6. Calculate the electric potential at the intersection point P of the diagonals of the square.

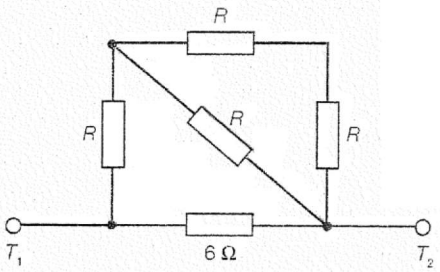
Figure 6



A. 2 000 V B. 2 830 V C. 4 000 V D. 5 660 V

17. In the resistance network shown in Figure 7, the resistance across the terminals T_1 and T_2 is 4 Ω. What should be the resistance of R ?

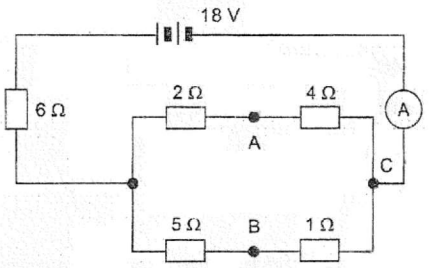
Figure 7



A. 3.0 Ω B. 6.0 Ω C. 7.2 Ω D. 9.0 Ω

18. A closed circuit is shown in Figure 8. What is the voltage across points A and B?

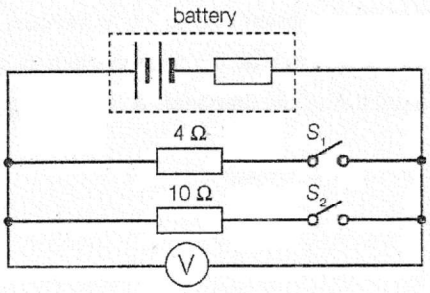
Figure 8



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

19. In the circuit shown in Figure 9, the voltmeter has very high resistance, and the internal resistance of the battery is not negligible. When S_1 only is closed, the voltmeter reads 8 V. When S_2 only is closed, the voltmeter reads 10 V. What will be voltmeter reading when both switches are closed?

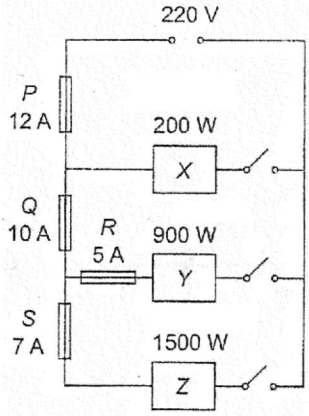
Figure 9



A. 4.0 V B. 4.6V C. 7.1 V D. 9.4V

20. In the circuit shown in Figure 10, electrical appliances *X*, *Y* and *Z* have the ratings of '220 V, 200 W', '220 V, 900 W' and '220 V, 1500 W' respectively. Fuses *P*, *Q*, *R* and *S* have fuse values of 12 A, 10 A, 5 A and 7 A respectively. If all the electrical appliances are switched on, which fuse will blow?

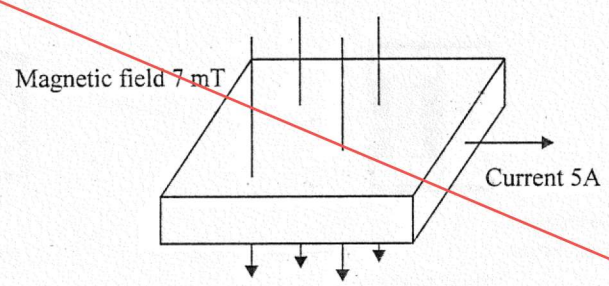
Figure 10



A. *P* B. *Q* C. *R* D. *S*

21. In the conductor shown in Figure 11, there are 3×10^8 charge carriers moving at 3 mm s^{-1}, the charge of each charge carrier is 2 mC. The current flowing in the conductor is 5 A and the conductor is placed perpendicularly in a magnetic field of 7 mT. What is the magnetic force acting on each charge carrier?

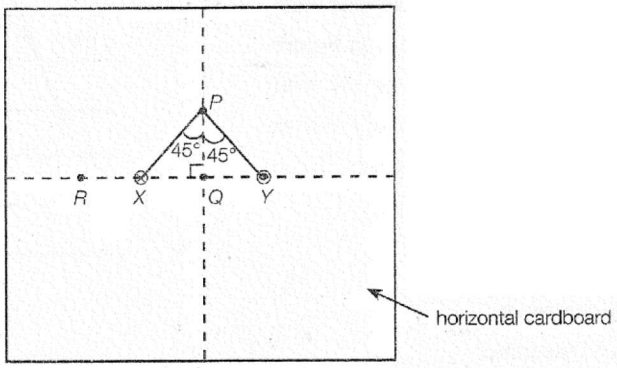
Figure 11



A. 1.3×10^{-8} N B. 2.2×10^{-8} N C. 3.6×10^{-8} N D. 4.2×10^{-8} N

22. Two vertical wires *X* and *Y* carrying equal currents pass through a horizontal cardboard. Figure 12 shows the top view of the arrangement. Current in *X* flows into the paper and current in *Y* flows out of the paper. *P*, *Q* and *R* are three points on the horizontal cardboard, *Q* is the mid-point of the line joining *X* and *Y* and $PQ = QX = XR$. Neglecting the Earth's magnetic field, which of the following statements are correct?

Figure 12

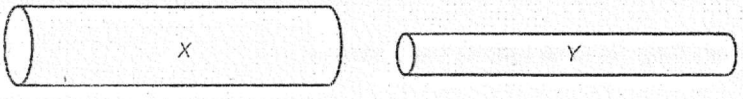


(1) The magnetic field strengths at *P* and *Q* act in the same direction.
(2) The magnitude of the magnetic field strength at *P* is one half that at *Q*.
(3) The magnitude of the magnetic field strength at *R* is one half that at *Q*.

A. (1) and (2) only B. (1) and (3) only C. (2) and (3) only D. (1), (2) and (3)

23. As shown in Figure 13, *X* and *Y* are two long hollow paper cylinders; *Y* has the same length but half the radius of *X*. *X* is uniformly wound with a thin insulated wire to become a long solenoid. When a current *I* is passed through the solenoid *X*, the magnetic flux density at its centre is *B*. Now the same piece of wire is removed from *X*, and wounded uniformly on *Y*, allowing overlapping of layers of wire. If now a current 2 *I* is passed through solenoid *Y* the magnetic flux density at its centre would be

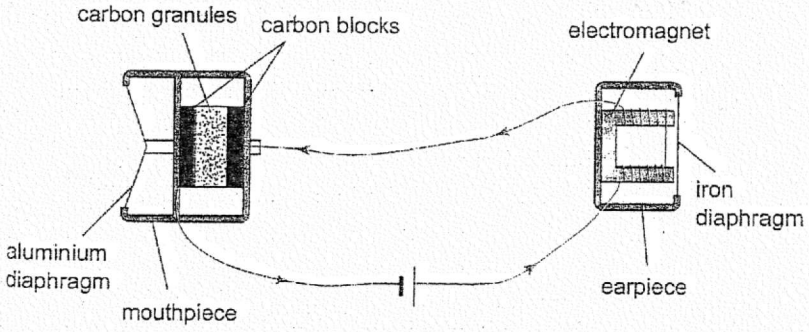
Figure 13



A. *B* B. 2*B* C. 4*B* D. 8*B*

24. Figure 14 shows a simple telephone system. Which of the following does not happen when we speak against the mouthpiece?

Figure 14



A. The resistance between the two carbon blocks varies.
B. The current flowing through the wire linking the mouthpiece and the earpiece varies.
C. The strength of the electromagnet varies.
D. The iron diaphragm is attracted and repelled alternatively by the electromagnet.

25. A square coil *WXYZ* of 50 turns and length of side 0.2 m is placed in a uniform magnetic field of flux density 0.6 T. The magnetic field lies in the plane of the coil as shown in Figure 15. The side *WX* makes an angle of 30° with the magnetic field. When a current of 0.8 A is passed in the coil, find the magnetic force acting on *WX* of the coil at this instant.

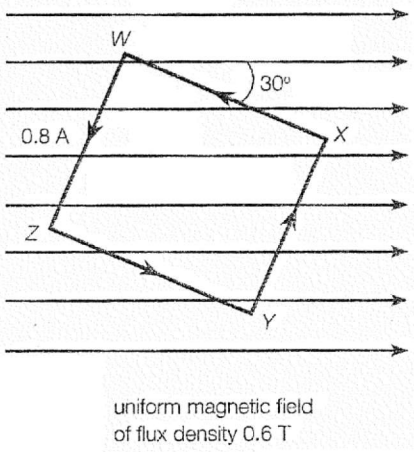
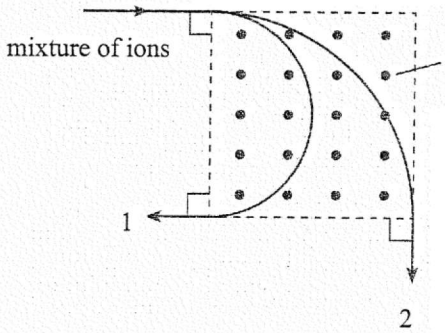


Figure 15

A. 2.4 N out of the paper
B. 2.4 N into the paper
C. 4.2 N out of the paper
D. 4.2 N into the paper

26.

Figure 16

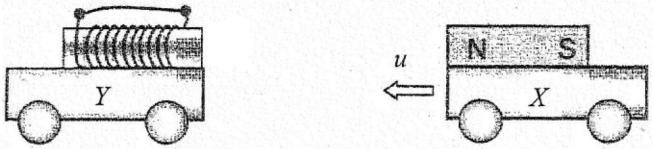


A beam consisting of two types of positive ions 1 and 2 moving at the same speed enters a square region of uniform magnetic field as shown in Figure 16. They are deflected by the magnetic field and leave the region of the magnetic field along the directions indicated. Given that the charge to mass ratio $(\frac{q}{m})$ of ion 1 is x, the charge to mass ratio of ion 2 must be

A. $2x$ B. $1.5x$ C. x D. $0.5x$

27. A bar magnet and a solenoid are fixed on trolley X and trolley Y respectively, such that the loaded trolleys have equal mass. They are placed on a smooth horizontal surface. The terminals of the solenoid are joined together. Initially Y is stationary and X is given an initial velocity u as shown in Figure 17. Which of the following statements is/are correct?

Figure 17

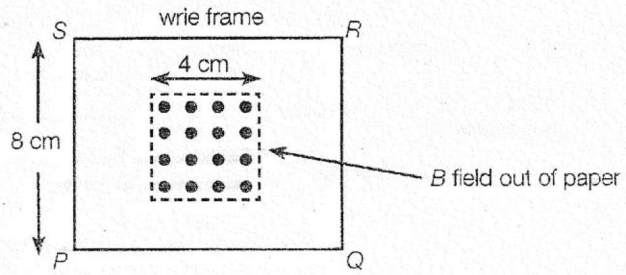


(1) As X approaches Y, they experience a repulsive- force.
(2) The total kinetic energy of the trolleys remains constant before and after collision.
(3) Eventually, X stops and Y moves with a constant velocity u.

A. (1) only B. (3) only C. (1) and (2) only D. (2) and (3) only

28.

Figure 18

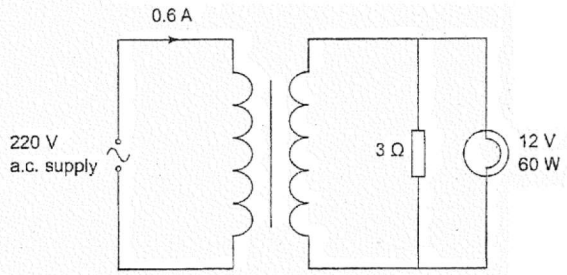


A rectangular wire frame $PQRS$, of side 8 cm, surrounds a uniform magnetic field which is confined to a square region of side 4 cm as shown in Figure 18. The magnetic field is situated at the centre of the frame and points perpendicularly out of the plane of the paper. If the magnetic flux density decreases at a constant rate from 0.5 T to zero in 25 s, what is the magnitude of the induced e.m.f. and the direction of the induced current in the wire frame during this time interval ?

	Magnitude	**Direction**
A.	3.20×10^{-5} V	*PQRS*
B.	3.20×10^{-5} V	*SRQP*
C.	1.28×10^{-4} V	*PQRS*
D.	1.28×10^{-4} V	*SRQP*

29.

Figure 19

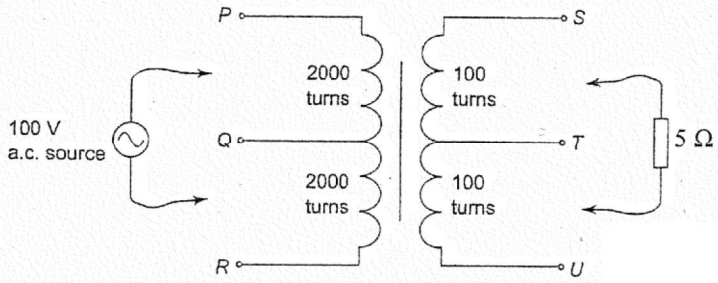


In the circuit shown in Figure 19, the lamp is working at the rated value of '12 V, 60 W' and the current in the primary coil is 0.6 A. Find the efficiency of the transformer.

A. 64 % B. 75 % C. 82 % D. 90%

30.

Figure 20



The primary coil and the secondary coil of a transformer have 4000 turns and 200 turns respectively. The coils can be tapped at the middle as shown in Figure 20. A 100 V a.c. source and a 5 Ω resistor are to be connected to the primary coil and the secondary coil respectively. Which of the following connections gives the maximum power of dissipation in the resistor?

	A.c. source	**Resistor**
A.	to *P*, *Q*	to *S*, *T*
B.	to *P*, *Q*	to *S*, *U*
C.	to *P*, *R*	to *S*, *T*
D.	to *P*, *R*	to *S*, *U*

***** End of Section A *****