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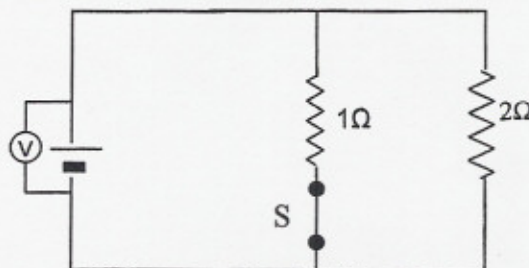
IN THEIR OWN INTERESTS STUDENTS ARE REQUESTED TO WRITE LEGIBLY.
THIS PAPER CONSISTS OF 7 PAGES and 3 COLOURED ANSWER SHEETS. PLEASE SEE
THAT YOU HAVE THEM ALL.

MULTIPLE CHOICE QUESTIONS

All correct answers are awarded 3 marks

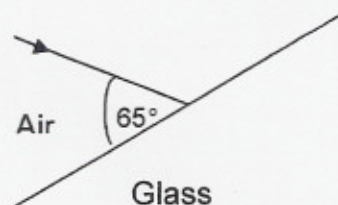
Answer these multiple choice questions on the separate ANSWER SHEET by putting a cross (x) over the letter that corresponds to the best answer.


Questions 1 to 3 **all refer** to the adjacent circuit diagram and question.

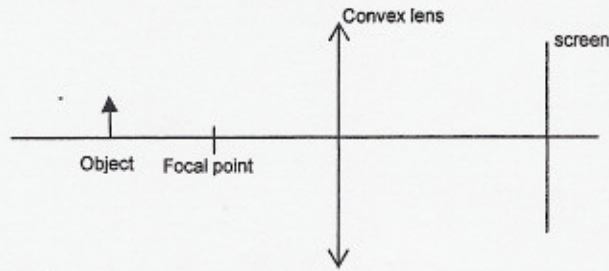


If the closed switch (S) is opened, how will it affect the following?





1. The current through the battery will
(a) increase (b) decrease (c) stay the same (d) become zero
2. The internal resistance of the battery will
(a) increase (b) decrease (c) stay the same (d) become zero
3. The voltmeter reading will
(a) increase (b) decrease (c) stay the same (d) become zero
4. The drawing shows a light ray incident at an air-glass surface. The angle of refraction will be:
(a) less than 25° (b) 25°
(c) between 25° and 65° (d) 65°



5. A illuminated object  creates an image on the screen by means of a lens as shown.



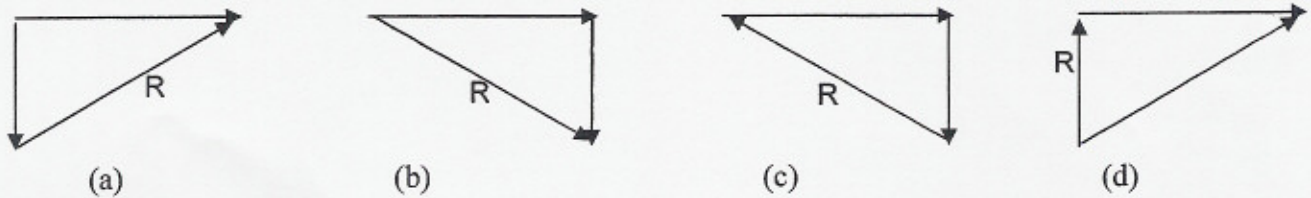
If the top part of the lens is covered, what will be the appearance of the image?

- (a)  (b)  (c)  (d) 

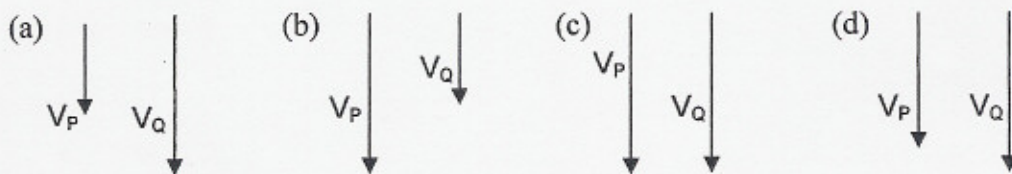
6. An instrument that uses the principle of total internal reflection is:

- (a) spectacles for someone with short sight. (b) a magnifying glass
(c) the driver's rear view mirror in a car (d) a fibre optic cable

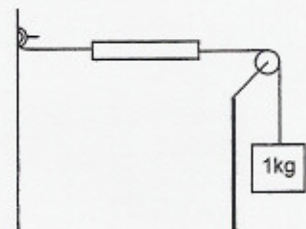
7. Which one of the vector diagrams given below shows the resultant vector (R) correctly?



8. Sphere P of mass m and sphere Q of mass $2m$ are dropped from the same height. Ignore the effects of air resistance and consider the situation just before they strike the ground. Which pair of velocity vectors correctly shows the velocities of spheres P and Q?



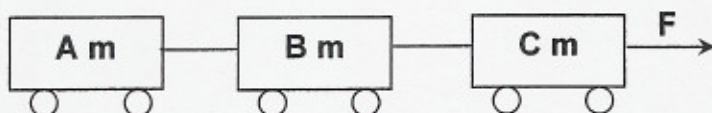
9. A spring balance is attached to a hook on the wall. The other end of the balance is attached to a 1.0kg mass piece by means of a light, inextensible string passing over a frictionless pulley. What will be the reading on the spring balance? ($g = 9.8\text{m}\cdot\text{s}^{-2}$)



- (a) 1.0N (b) 9.8N
(c) 0.98N (d) $9.8 \times 10^3\text{N}$

10. Which one of the following statements about inertia is correct?
- Inertia is the force that must be overcome before a body can move.
 - The acceleration of a body is directly proportional to its inertia.
 - Only bodies that are in equilibrium (with no resultant force acting on them) have inertia.
 - Inertia is the property of a body that makes it tend to keep moving at constant velocity when the resultant force is zero.

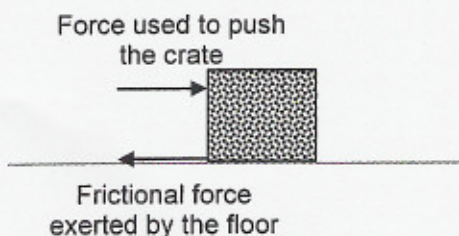
11. Three frictionless trolleys, each with a mass of m , are pulled to the right by force F .



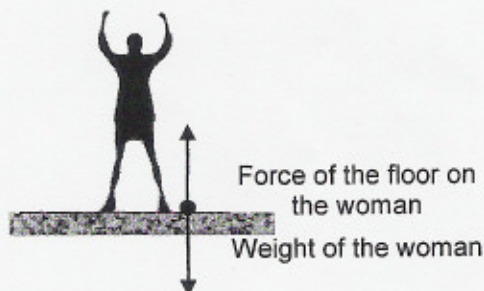
What is the acceleration of trolley A? (Ignore the effect of friction.)

- $\frac{3F}{m}$
 - $\frac{F}{3m}$
 - $\frac{F}{m}$
 - $\frac{3m}{F}$
12. Which one of the following pairs of forces correctly illustrate Newton's third law?

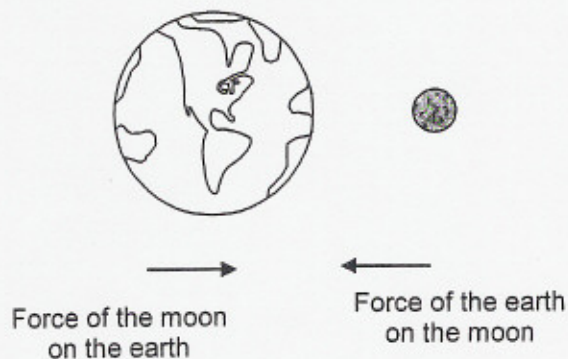
- (a) A crate moving with constant velocity



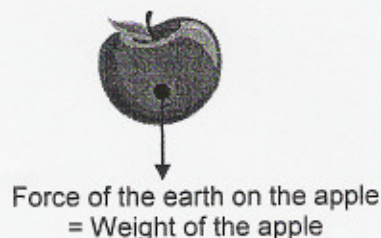
- (b) A woman standing still



- (c) The moon orbiting the Earth



- (d) An apple falling to earth



Now answer Questions 13 to 16 ON YOUR COLOURED ANSWER SHEET

TOTAL SHORT QUESTIONS 60 marks

LONG QUESTIONS

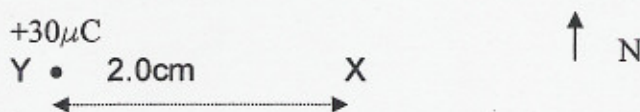
Answer these questions **in the answer book provided**. Number your questions carefully and show all your working and explanations. You may write in pencil.

Properties of matter

1. A block of blue wax has a mass of 32.7 g and a volume of 36.3cm^3 . It is melted and mixed with 50.2g of pink wax. The mixed wax has a density of 0.88g/cm^3 .
- (a) Find the volume of the pink wax (5)
- (b) What is the density of the pink wax? (2)
- (c) Another piece of blue wax has a volume of 20.5cm^3 . What is its mass?
Draw a diagram and explain your reasoning – do not just show a calculation. (7)

Electrostatics ($k = 9.0 \times 10^9 \text{Nm}^2\text{C}^{-2}$)

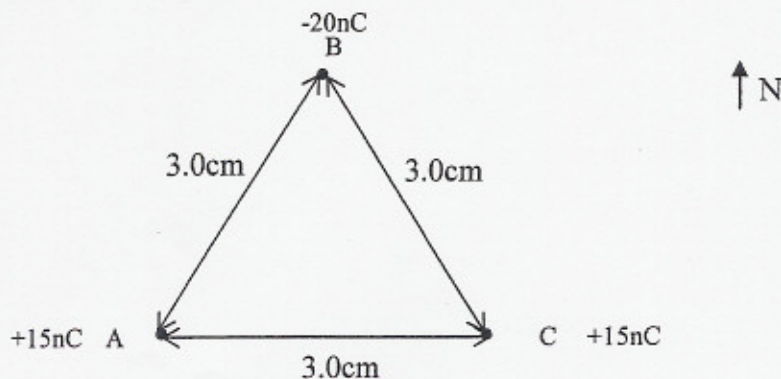
2. The diagram shows a point X, which is 2.0cm away from a $+30\mu\text{C}$ charge.



- (a) Determine the electric field at point X (5)

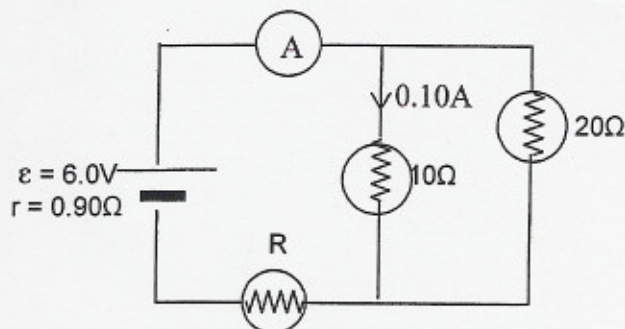
If a $-50\mu\text{C}$ charge (P), is now placed at X:

- (b) Determine the force exerted by charge Y on P. (4)
- (c) How would the electrical potential energy of the negative charge (P) change as it
- (i) moves closer to Y; (2)
- (ii) moves in a circle, of diameter 2 cm, round Y. (2)
3. Three point charges are placed in the form of an equilateral triangle, as shown below. Determine the resultant electrostatic force exerted on B. (10)



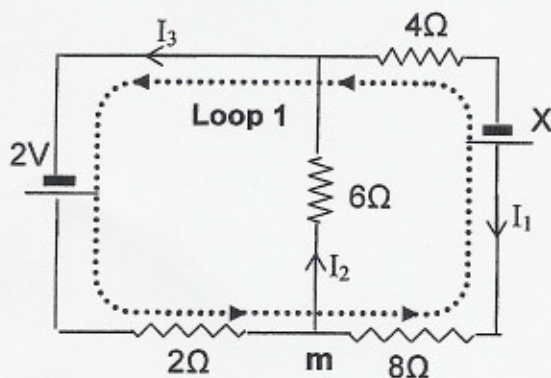
Electric Circuits

4. Answer the following questions for the circuit shown below.



- (a) What is the reading on the ammeter, A ? (2)
- (b) Calculate the resistance of resistor R (5)
- (c) What is the terminal voltage when current flows? (3)

5. Consider the circuit shown below, then answer the questions below it.

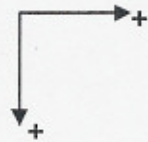


- (a) Apply Kirchoff's first law to node **m** to write down an equation. (1)
- (b) Use Kirchoff's second law to write down an equation for loop 1. (5)

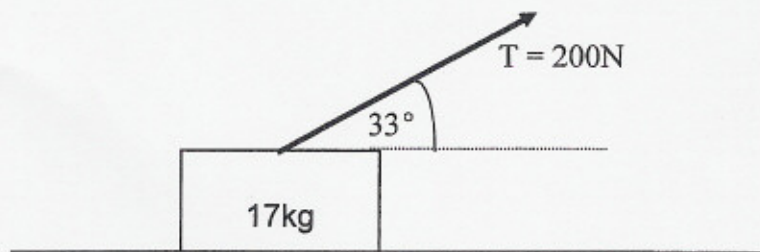
**NOTE: There are no marks allocated for solving these equations mathematically.
Do not try to solve them!**

Mechanics ($g_{\text{Earth}} = 9.8\text{m/s}^2$)

6. After being flicked, a 5.0g marble rolls 1.4m across a table which offers a frictional force of 0.015N. At the edge of the table the marble has a velocity of 2.8m/s. It drops on to the floor 0.75m below. Use the reference frame provided opposite.



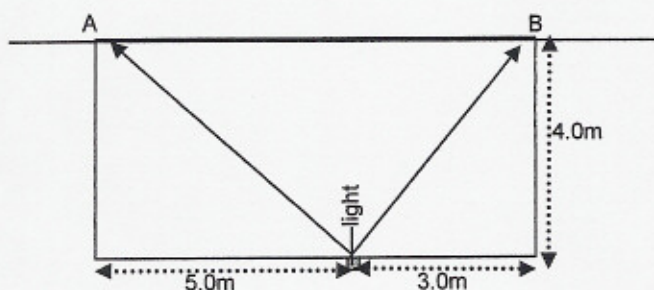
- (a) How far from the base of the table does the marble land? (8)
- (b) With what velocity does it strike the ground? (8)
- (c) What was the initial velocity of the marble when it was flicked across the table? (7)
- (d) For the **horizontal motion** of the marble from the time it was flicked to when it landed on the floor, draw neat sketch graphs of
- (i) position versus time
- (ii) velocity versus time
- (iii) acceleration versus time (9)
7. The diagram shows a box that is pulled across the floor with the rope making an angle of 33.0° with the floor. There is a frictional force of 51N acting between the floor and the box and the tension in the rope is 200N.



- (a) What is the acceleration of the box? (6)
- (b) If the angle between the rope and the floor is increased, at what angle will the box **just** lift off the floor? (4)

Optics ($n_{\text{water}} = 1.33$)

8. A butterfly, at eye level, is 20cm in front of a plane (straight) mirror. Imagine that you are behind the butterfly, 50cm from the mirror. What is the distance between your eye and the image of the butterfly in the mirror? Use a diagram to explain your answer. (2)
9. An underwater light is placed on the bottom of a swimming pool as shown. The direction of the beam of light can be changed.

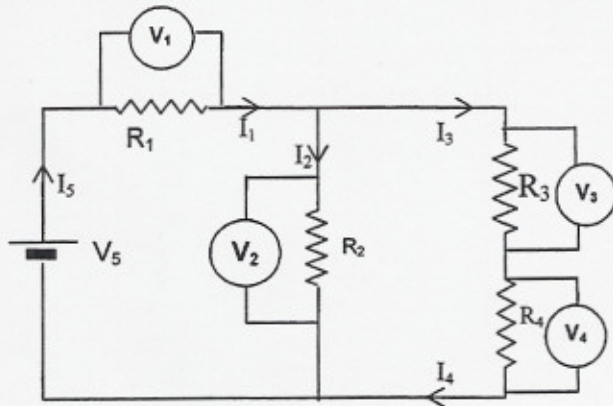


- (a) When light shines towards B, at what angle of refraction does the beam of light leave the water? (6)
- (b) When light shines towards A, it cannot be seen at A. Explain this observation, using a calculation to help. (6)
10. A camera is used to photograph a flower that is 22cm high and 0.5 metres away from the camera lens. The height of film for the image is 2.5cm.
- (a) (i) Is the image upright or inverted?
(ii) Is the image real or virtual? (2)
- (b) The photographer wants the image of the flower to fill the film, calculate the distance that there should be between the lens and the film. (6)
- (c) Calculate the focal length of this lens. (3)

TOTAL LONG QUESTIONS 120 marks

14. The diagram represents a circuit in which the resistors have the following relative values: $R_1 < R_2 < R_3 < R_4$.

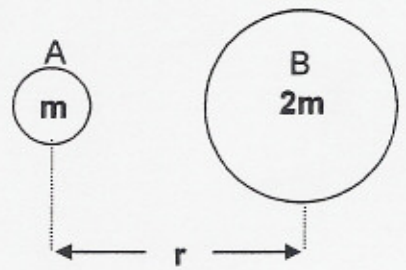
Use it to answer the following statements, by saying which statements are TRUE or FALSE. (Ignore internal resistance) (10)



- (a) $I_2 = I_3$ _____
- (b) $V_2 = V_5$ _____
- (c) $I_3 = I_4$ _____
- (d) $I_1 = I_2 + I_3 + I_4$ _____
- (e) $V_2 = V_3 + V_4$ _____
- (f) $R_2 = R_3 + R_4$ _____
- (g) $R_{total} = R_1 + \frac{1}{R_2} + \frac{1}{R_3 + R_4}$ _____
- (h) $V_5 = V_1 + V_2$ _____
- (i) $V_3 = V_4$ _____
- (j) $V_5 = V_2 + V_3 + V_4$ _____

Please turn over for questions 15 and 16

15. Two masses: A with mass m and B with mass $2m$ are a certain distance apart as shown opposite. The force that A exerts on B is 5N .



- (a) What is the direction of this force F_{AB} ? _____ (1)
- (b) What is the magnitude of the force that B exerts on A? _____ (1)
- (c) If the mass A is replaced with a mass of $10m$, and the distance between the masses is also doubled, what will be the magnitude of the force that A exerts on B?

_____ (2)

16. The diagram below shows a **diverging** lens with focal points marked. Complete the paths of rays A and B from the object. Show the position of the image formed, and label it I. (3)

