

2021/2022 SEMESTER ONE EXAMINATION

Diploma in Electrical & Electronic Engineering (DEEE)
2nd Year Full-Time

PHYSICS FOR ENGINEERS

Time Allowed: 2 Hours

Instructions to Candidates

1. The examination rules set out on the last page of the answer booklet are to be complied with.
2. This paper consists of **TWO** sections :

Section A - 15 Multiple Choice Questions, 2 marks each (Total 30 marks).
Section B - 5 Short Questions, 14 marks each (Total 70 marks).
3. **ALL** questions are **COMPULSORY**.
4. All questions (Section A and B) are to be answered in the answer booklet.
5. The MCQ answers to Section A should be ticked on the back of the cover page of your answer booklet.
6. Start each question in Section B on a new page.
7. Fill in the Question Numbers, in the order that it was answered, in the boxes found on the front cover of the answer booklet under the column "Question Answered".
8. This paper consists of **9** pages.

SECTION A

MULTIPLE CHOICE QUESTIONS [Total 30 marks - 2 marks each]

1. Please tick your answers in the boxes behind the front cover of the answer booklet.
 2. No marks will be deducted for incorrect answers.
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A1. The normal reaction force from the surface acting on the mass in Figure A1 is _____.

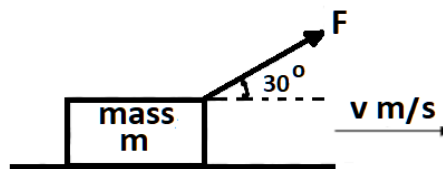


Figure A1

- (a) mg
 - (b) $mg - F \sin 30^\circ$
 - (c) $mg + F \sin 30^\circ$
 - (d) $mg - F \cos 30^\circ$
- A2. Figure A2 shows a block of mass m . If the angle of the inclination increases, the friction experienced by the block of mass m will _____.

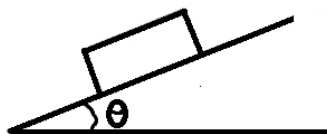


Figure A2

- (a) decrease
- (b) increase
- (c) greater than 1
- (d) remain unchanged

A3. _____ gears are best use to change the plane of rotation.

- (a) spur
- (b) bevel
- (c) worm
- (d) helical

A4. Which of the following statements is TRUE?

- (a) Specific Heat Capacity is the internal energy of an object due to the kinetic energy of its atoms and/or molecules.
- (b) Specific Heat Capacity of a substance is the amount of heat per unit mass required to raise the temperature of the substance by one degree Celsius.
- (c) Specific Heat Capacity is the amount of heat that is added per unit mass for a phase change to occur in a given material.
- (d) Specific Heat Capacity is the amount of heat released when one mole of a substance is completely oxidized or burnt.

A5. Two liquid specimens, A and B, with the same mass were left at room temperature in a laboratory test. Specimen A evaporated completely in 5 minutes while specimen B took 30 minutes to evaporate completely. Which of the following statements more accurately describes the characteristics of the specimens?

- (a) The Latent Heat of Fusion of specimen A is greater than specimen B.
- (b) The Latent Heat of Fusion of specimen B is greater than specimen A.
- (c) The Latent Heat of Vaporization of specimen A is greater than specimen B.
- (d) The Latent Heat of Vaporization of specimen B is greater than specimen A.

A6. Water pipes may burst during very cold weather because _____.

- (a) water expands on freezing
- (b) ice expands on melting
- (c) water pipes expand when cooled
- (d) None of the above is true.

A7. A 100MHz wave signal is in _____ band.

- (a) MF
- (b) HF
- (c) VHF
- (d) UHF

A8. The advantages of optical fibre communication system are

- (a) low attenuation and wide bandwidth
- (b) low attenuation and narrow bandwidth
- (c) high attenuation and narrow bandwidth
- (d) high attenuation and wide bandwidth

A9. The refractive index of plastic in Figure A9 is _____.

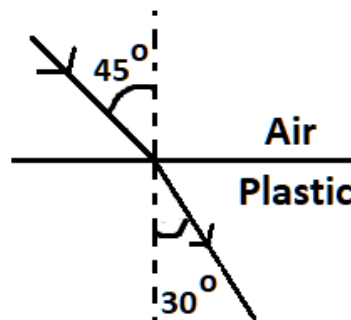


Figure A9

- (a) 0.67
- (b) 0.707
- (c) 1.414
- (d) 1.5.

A10. In an experiment to detect the speed of sound with air, water and steel, it was found that _____ . V is the speed.

- (a) $V_{\text{air}} > V_{\text{water}} > V_{\text{steel}}$
- (b) $V_{\text{air}} > V_{\text{water}} = V_{\text{steel}}$
- (c) $V_{\text{air}} < V_{\text{water}} > V_{\text{steel}}$
- (d) $V_{\text{air}} < V_{\text{water}} < V_{\text{steel}}$

- A11. When flying away from a control station at constant speed, the aircraft continuously sent a radar signal to the control station. The frequency of the echo _____ the transmitted frequency.
- (a) is lower than
 - (b) is higher than
 - (c) the same as
 - (d) independent of
- A12. A pond having a vibrating device working at a frequency of 30 Hz produces waves in a fluid. If 25 waves cover a distance of 50 cm, the velocity of the wave is _____ cm/s.
- (a) 53
 - (b) 60
 - (c) 530
 - (d) 600
- A13. Which of the following principles does not relate to forces and torques production in electrical machines?
- (a) Alignment of flux lines.
 - (b) Principle based on Lorentz Force Law.
 - (c) Interaction between electric fields and current-carrying conductors.
 - (d) Interaction between magnetic fields and current-carrying conductors.
- A14. Which of the following is true about a DC motor?
- (a) Permanent magnets must be used for the stator of the motor.
 - (b) It can also perform as a DC generator.
 - (c) The terminal voltage, also known as the armature voltage, is proportional to the speed of rotation irrespective of the loads.
 - (d) It converts mechanical power to electrical power.
- A15. A Variable Reluctance Stepper Motor _____.
- (a) has a permanent magnet rotor.
 - (b) has a permanent magnet stator.
 - (c) produces a highest torque when operating in One-phase ON mode.
 - (d) produces a highest torque when operating in Two-phase ON mode.

SECTION B [Answer all questions – 70 marks]

- B1a. Derive the relationship between
- (i) Impulse and momentum (4 marks)
 - (ii) Power, force and velocity (4 marks)
- b. With reference to Figure B1, find the combined power from the 2 forces to effect the situation shown in the figure. (6 marks)

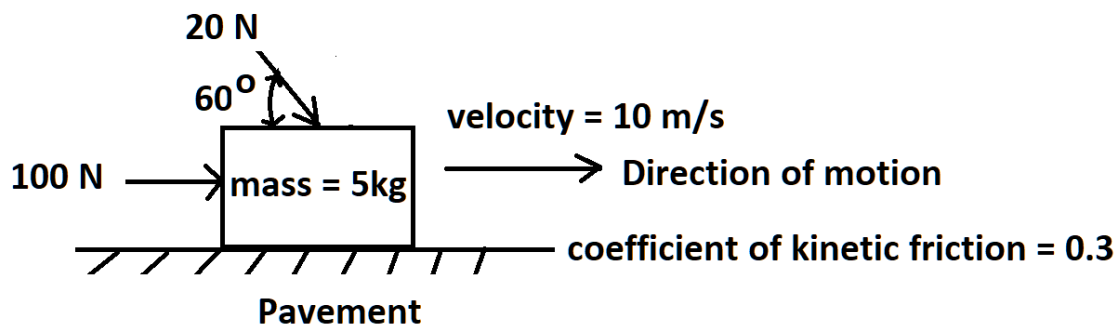


Figure B1

- B2a. List three ways that heat may be transferred between substances at different temperature. (3 marks)
- b. Heat is added to material A with specific heat capacity of $1.1 \text{ J/g } ^\circ\text{C}$ to raise its temperature from 0°C to 60°C . The same amount of energy is needed to heat up material B of specific heat capacity of $0.50 \text{ J/g } ^\circ\text{C}$ and has twice the mass of A. If material B's temperature before heating up is 20°C , what is its final temperature? (6 marks)
- c. The cooling water cylinder of a steel boiler has an internal cross sectional area of 10 m^2 . The 20 cm thick cylinder has a thermal conductivity of $14 \text{ J/s}\cdot\text{m}\cdot^\circ\text{C}$. The temperature of the water inside the cylinder is 60°C and the external temperature surrounding the cylinder is 30°C . Calculate the amount of heat energy being transfer from the water cylinder to the surrounding per hour. (5 marks)

- B3a. A 2 cm size object is placed 8 cm from the centre of a concave lens which has a focal length of 5 cm. Determine the distance of the image from the centre of the lens. Is the image real or virtual? (6 marks)
- b. For Figure B3, the light at 3×10^8 m/s in the air enters the medium X. Determine the
- (i) refractive index of medium X (3 marks)
 - (ii) speed of light in medium X (2 marks)
 - (iii) critical angle of medium X when light travels from the medium to the air. (3 marks)

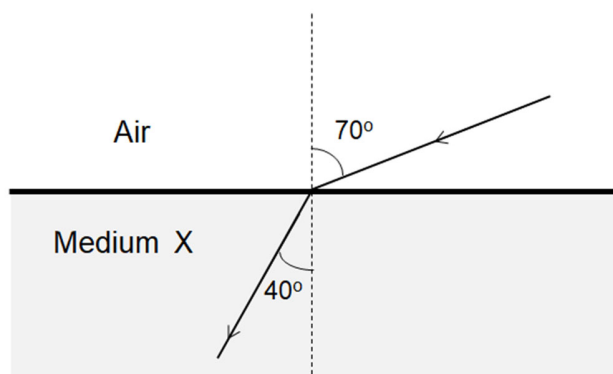


Figure B3

- B4a. Draw a detail standing wave to show its important features. Describe what cause a standing wave to form. (6 marks)
- b. Draw and describe how two waves interfere with one another if they are in phase and 180° out of phase. Assume the amplitudes of the two waves are the same. (6 marks)
- c. A man saw a flash of lighting followed by hearing a loud thunder 15 seconds later. If the speed of sound in air is 0.4 km/s, how far was the man from the lightning discharge? (2 marks)

- B5a. The rod in Figure B5 rests on a frictionless surface. The magnetic field strength B is 1.5 Tesla. Assume that the wires attached to the rod has no mass and freely extendable. At time $t = 0$ s, the switch is closed.

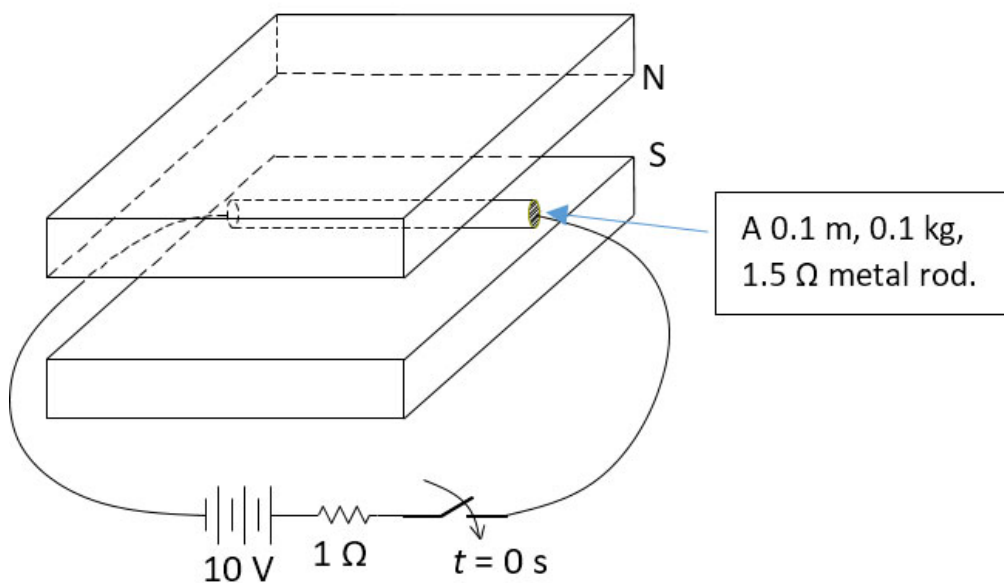


Figure B5

- (a) Determine the force on the rod. (5 marks)
- (b) In which direction does the force acts on the rod? You should describe the direction as 'towards me', 'away from me', 'sideway to the right', and 'sideway to the left', 'upwards' or 'downwards'. (3 marks)
- (c) Determine the initial acceleration of the rod. (2 marks)
- (d) Just next to rod but not touching is a second rod (not shown in the figure) of the same length and a perfect conductor of 0.4 kg mass. Assuming the first rod gets attached to the second rod the moment it moves. Determine the acceleration of the combined rod assembly. (4 marks)

~ End of Paper ~

Formulae Sheet

1. $g = 9.8 \text{ m/s}^2$
2. $F = BIL$
3. Centripetal acceleration $= v^2 / r$
4. $v = u + at$
5. $v^2 = u^2 + 2as$
6. $s = ut + \frac{1}{2} at^2$
7. Young's modulus $Y = \text{stress/strain}$
8. One tonne = 1000 kg
9. $v = f \lambda$
10. Heat Energy Transferred $= m c \Delta t$
11. $\frac{Q}{t} = \frac{kA(T_2 - T_1)}{d}$
12. Snell's law: $n_i \sin \theta_i = n_r \sin \theta_r$
13. $K = ^\circ\text{C} + 273$
14. $^{\circ}\text{F} = (9/5) ^\circ\text{C} + 32$